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BULLETIN

OF THE

MOUNT WEATHER OBSERVATORY

PREPARED UNDER THE DIRECTION OF
WILLIS L. MOORE, D. Sc., LL. D.
CHIEF U. S. WEATHER BUREAU

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STAFF

OF THE

MOUNT WEATHER OBSERVATORY.

WILLIS L. MOORE, *Director.*
ALFRED J. HENRY, *Executive Officer.*
WILLIAM J. HUMPHREYS, *Supervising Physicist.*
CLEVELAND ABBE, *Editor.*

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BULLETIN

OF THE

MOUNT WEATHER OBSERVATORY

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(I) ORIGIN OF THE PERMANENT OCEAN HIGHS.

By W. J. HUMPHREYS.

[Dated December 19, 1910.]

INTRODUCTION.

There are five barometric highs on the oceans, as indicated by figure 1, that remain substantially fixed in position throughout the year though of varying intensity. Two of these are approximately 35° north of the Equator and three about 32° south of it. Two occur in the Pacific Ocean, one just west of southern California, the other near the coast of Chile; two in the Atlantic Ocean, near Morocco and southern Africa, respectively; and one in the Indian Ocean about half way between southern Africa and Australia.

There necessarily is a close relation between the locations and intensities of these ocean highs and the weather of the adjacent continents, and therefore they deserve careful study. But while they themselves and their results are more or less discussed in works on meteorology, it appears that, in spite of their importance, but few attempts have been made to explain their origin.

Ferrel[1] holds that a portion of the west to east winds of the higher latitudes is deflected toward the Equator by every continental barrier and thereby forced to join, at each of these places, the counter winds within the Tropics, and to produce that whirl of the anticyclonic type that exists on the adjacent ocean. In each of these cases the direction of the wind is such that it exerts a pressure toward the center about which it moves, due, as it will be explained below, to the rotation of the earth; and Ferrel maintains that this forced or mechanical pressure is the cause of the permanent barometric highs of the oceans. He does not consider, in this connection, surface or other temperature differences, though, as it will be shown, they are of especial importance.

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[1] Recent Advances in Meteorology, pp. 224-226, Washington, 1886. (Annual Report of the Chief Signal Officer, 1885, Appendix 71.) Also, A Popular Treatise on the Winds, pp. 184-187, 1889.

The above explanation is both suggestive and ingenious, but as the west to east winds of the Southern Hemisphere pass to the south of Africa in January and February, as shown by figure 2, it is not clear how the barometric high in the southern Atlantic can be accounted for on the barrier hypothesis. Again, if the high barometer is not due, in part at least, to thermal causes, but entirely to mechanical constraint, it must follow that the surface winds would have an inward and the upper winds an outward component. This assumed direction, however, according to figures 2 and 3, is just the reverse of that which actually exists.

Clearly then Ferrel's hypothesis of the origin of the permanent anticyclones of the oceans does not account for all of the observed facts. Mountain and continental barriers may be contributory, but certainly not the only causes.

An entirely different explanation of the same phenomena has been given by Angot [2] based on the fact that on every parallel between the latitudes 45° north and south the average surface temperature of continents is higher than that of the oceans. The barometer, therefore, within the belts of highs (latitudes 30° to 35° in both hemispheres) where the atmospheric pressure is greater than it is on either side, is lowered over the continents and correspondingly raised over the oceans; and this, he claims, explains why these belts have pressure maxima with closed isobars.

This hypothesis accounts for the pressure in the belts of highs being less on the continents than over the oceans; but, without further modification, it would appear to call for anticyclonic centers not far from mid-ocean, though rather nearer the largest continent. We would also expect those of the Northern Hemisphere to be more pronounced than the corresponding highs of the Southern Hemisphere, because of the greater differences there in temperature, due to the extensive land areas.

As a matter of fact the high of the southern Pacific and the high of the southern Atlantic are fully equal to their companions north of the Equator. The one in the Indian Ocean of course can have no counterpart in the other hemisphere, and hence is not to be considered in this comparison. Besides, all these highs, except that of the Indian Ocean, occur far from mid-ocean and off the west coasts where, for some distance inland, the continents are not so warm as they are on the eastern side.

Hence it appears that this (the only other explanatory hypothesis a considerable search of the literature has revealed), while accounting for much, is not adequate to explain all the phenomena.

---

[2] Traité Élémentaire de Météorologie, 2d ed., 158-159, Paris, 1907.

BELTS OF HIGHS.

In order to understand the chief causes of the permanent ocean highs, it is necessary to consider certain wind and pressure effects due to the combined influence of temperature gradients and terrestrial rotation, a subject first and admirably developed by Ferrel.

Consider a plastic rotating planet, homogeneous throughout, or at least with reference to the center. Under these conditions the planet is an ellipsoid of revolution, with the axis of rotation shorter than the equatorial axis, to an extent dependent upon the angular velocity.

Let the rotation be about the axis *NS*, Fig. 4, then a point on the surface at *s* will move in a circle whose radius is *r*, and will have an acceleration toward this center equal to $\frac{v^2}{r}$, in which *v* is its linear velocity. Therefore, to restrict a mass *m*, with linear velocity *v*, to a circle whose radius is *r* requires a centrally directed force whose numerical value is $\frac{mv^2}{r}$; and of course the reaction, called "centrifugal force," is equal in magnitude but opposite in direction.

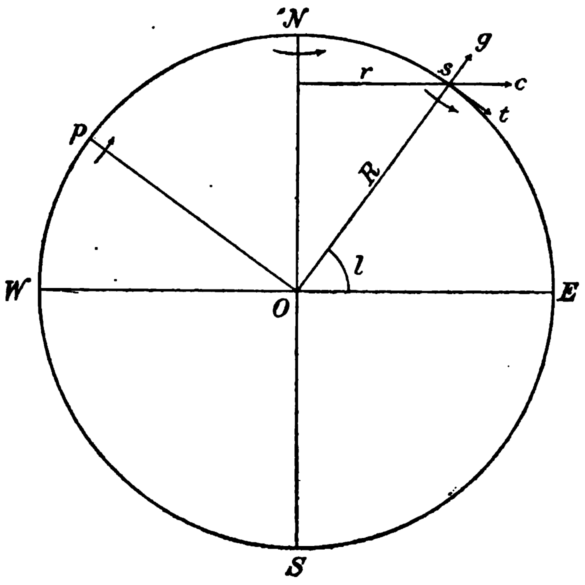

FIG. 4.

Let *sc* represent the direction and magnitude of the "centrifugal force" acting on a mass *m* at the point *s*. The effect of this is to decrease the weight of the mass *m*, by an amount represented by *sg*, and to thrust it towards the equator with the force *st*. Hence we can write

$$f=\frac{mv^2}{r}\sin l=\frac{mv^2}{R}\tan l=m\omega^2R\sin l\cos l,$$

in which

f = the force on the mass m directed along the surface toward the equator,

v = the linear velocity of the mass m at the latitude l,

R = the radius of the sphere, and

ω = the angular velocity.

These of course are only approximately correct expressions, but where R is nearly constant, as in the case of the earth, they are sensibly correct.

The rotating spheroid will bulge till the gravitational pull down hill or toward the pole will equal the equatorial push up hill.

Since the weight, w, of a mass m is numerically equal to mg, where g is gravitational acceleration, therefore the equatorial push in terms of the weight is given by the equation

$$f=w.\frac{\omega^2}{g}R\sin l\cos l.$$

This has its maximum value, $\frac{w}{2}\cdot\frac{\omega^2}{g}\cdot R$, at latitude 45°, and its minimum, zero, at the equator and at both poles.

At latitude 45° on the earth

$$f=0.00173\ w\text{, approximately.}$$

That is to say, at this place every kilogram pushes toward the equator with a force equal to the weight of 1.73 grams. In other words, at this latitude to go a kilometer toward or from the Equator along a quiet water surface also implies going 173 centimeters from or toward the center of the earth.

Suppose the surface of the planet we are considering to be everywhere level, like the surface of undisturbed water, and to have the same temperature from pole to Equator.

An atmosphere on such a planet would rotate with it and be devoid of all circulation.

Now let the temperature increase uniformly from the poles to the Equator and we shall have a first approximation to the conditions on the earth. The air will expand everywhere proportionately to the increase in temperature, and hence will reach its highest levels at and near the Equator and will there overflow toward the poles. But in so doing the pressure at the surface near the Equator will be decreased while that of the adjacent higher latitudes will be increased, and hence a circulation will be started that will continue polewards in the upper levels and equatorwards in the lower, so long as the temperature differences are maintained.

Assuming no friction it follows, since all the acting forces are central, that, wherever any particle of the atmosphere may go, the radius connecting it perpendicularly with the axis of rotation must sweep over equal areas in equal times. That is, in terms of Fig. 4,

$$rU = RU \cos l = K,$$

in which U is the total velocity of the particle in the direction of rotation and K is a constant. Hence the velocity in the direction of rotation is not constant, but varies inversely with the cosine of the latitude. Neither does it depend in the least upon the *rate* of change of latitude, but wholly upon the *magnitude* of that change, however rapidly or however slowly effected.

With an atmosphere fixed in amount, the horizontal area of the region of upward convection can not differ very greatly from that of the opposite or downward movement. Hence, under the assumed conditions of a uniform temperature gradient, the upward movement is over approximately all that area between latitudes 30° north and south, while the downward movement covers the areas from these latitudes to the poles.

Hence, in general, the air of the warm belt will flow in the upper levels toward the colder regions and there move in the direction of rotation more rapidly than the surface of the planet itself, while the air of the colder sections will flow along the surface toward the warmer region, where it will rotate slower than the planet.

While the above assumed temperature distribution applies roughly to the earth, the assumption of no friction does not. Nevertheless it is the circulation from one latitude to another that gives to the atmosphere of the higher latitudes its strong eastward component and to that of the Tropics its westward component.

The friction between the earth and the air causes the eastward flowing winds to give the earth a torque or a turning moment in the direction of rotation; but as the forces arise within the earth itself, it must be subject to both the action and the reaction, and hence there can be no change in the speed of rotation. In other words, an eastward wind implies a westward wind somewhere else of equal but opposite torque on the earth.

We are now in position clearly to understand the origin of the belts of maximum barometric pressure that surround the earth on each side of and from 30° to 35° from the Equator.

Let $+u$ be the eastward and $-u$ the westward velocity of the wind at any given place with reference to the surface of the earth at the same place.

The equatorward push of a mass m moving with the velocity V of the earth, is given, as we have seen, by the equation

$$f = \frac{m}{R} V^2 \tan l.$$

Hence, the push of the same mass moving with the air is

$$f' = \frac{m}{R}(V \pm u)^2 \tan l.$$

Therefore, the difference, or the force with which a mass m of air, moving eastward (+) or westward (−) with the velocity u, pushes toward or from the Equator is given by the equation

$$f'' = f' - f = \frac{m}{R}(\pm 2Vu + u^2) \tan l.$$

When u is small in comparison with V, as it always is on the earth, except possibly near the poles, we can write

$$f'' = \pm \frac{2m}{R} Vu \tan l = \pm 2m\omega u \sin l.$$

The positive sign applies to winds moving eastward, the negative sign applies to winds moving westward.

The total push is obtained by taking the sum of those given by each separate m, u, and l.

Those winds that ordinarily have an eastward component are thirty degrees or more from the Equator, while those that as constantly blow westward lie between these latitudes, as shown by figures 2 and 3. Hence, outside these latitudes the thrust is toward the Equator, and within them it is away from the Equator, and therefore the result must be a change of barometric pressure with latitude, such that an isobaric surface surrounding the earth and near its surface shall be some what flattened at the poles, drooped to a gentle valley along the Equator, and raised to perceptible ridges along both the northern and the southern parallels near 30°.

In the foregoing only east and west winds have been considered, but both the sense of the deflecting force (to the right in the northern hemisphere, to the left in the southern) and its magnitude are independent of the direction of motion; and, as this fact also will be needed in what follows, a demonstration of it is given here.

Referring again to figure 4, let ω be the angular velocity about the axis NS and let a mass m be at the pole N and moving along the surface of the sphere with the velocity u. Obviously at first it can only move *away* from N, however, much it may later change the direction of its path with reference to the pole.

Now consider a plane fixed in space and tangent to the rotating sphere at N, and let the mass m move a short distance along this plane in any direction radially from N. The surface of the rotating sphere will pass with increasing speed under m. If the velocity u of the mass m is uniform, so also is the rate of increase of the speed, or the acceleration of the surface of the sphere, under *m*. If *f* is this acceleration, then the force that would have to be exerted on *m* to make it move with the sphere is numerically equal to *mf*. But the distance *X* that would be traveled by *m* during the time *t* in the direction of acceleration *f* is given by the equation

$$X=\frac{1}{2}ft^2.$$

If the distance from the pole at the time t_0 is d_0 and at the time *t* is *d*, and if these distances are not great enough appreciably to separate the plane from the surface of the sphere, then also

$$X=\omega t(d-d_0).$$

Therefore

$$f=2\omega\frac{d-d_0}{t}=2\omega u.$$

And

$$mf=2m\omega u.$$

Obviously the force exerted by *m*, or the reaction due to its inertia, is opposite in direction to the direction of rotation, or is toward the *right* at the North Pole and the *left* at the South Pole.

Hence, to find the deflecting force on a moving mass at any point *s* on the surface of the sphere, we have only to find the value of the rotation of the sphere about an axis passing through *s*.

Now rotation with the angular velocity ω about the pole *N* is equivalent to the sum of two others, namely, $\omega'=\omega\sin l$, about the pole *s*, and $\omega''=\omega\cos l$, about the pole *p*, where *p* and *s* are 90° apart and lie on a great circle passing through *N*.

An object moving on the surface of the sphere at *s* is not changing its distance from the axis through *p* and hence rotation about this axis does not affect its acceleration or exert any deflective force on it. We have then to consider only the rotation about the pole *s*. But, as we have seen, the general expression for such a force is

$$mf=2m\omega u.$$

where ω is the angular velocity at the position of *m*.

If ω is the actual angular velocity, then, as seen above, the effective angular velocity ω' at any other point is in the same direction and numerically equal to $\omega\sin l$, where *l* is the latitude of the place.

In general, then, the deflective force anywhere is given by the equation

$$mf=2m\omega u\sin l.$$

This value is independent of the direction of *u*, since all directions are equally away from the pseudopole at the instantaneous position of *m*.

In the northern hemisphere the deflective force is always to the right of the momentary direction of motion; in the southern hemisphere always to the left.

IRREGULARITIES IN THE BELTS OF HIGHS.

Both the two belts of highs are of irregular intensity, and the greater the amount of land crossed by a belt, as in the northern hemisphere, the greater this irregularity, due to differences in the temperature, direction, and force of the winds.

The warm continental areas, as Angot[3] says, weaken their portions of the high belts. They expand the air over them and more or less modify the directions of the winds. This is especially well seen in South America where the isobars, figure 1, approach each other from both ends of the continent.

But it is necessary to explain not only the breaking up of the belts of highs but also the location of the closed isobars, or centers of anticyclonic whirls, just west of continental areas, and the deflection of these isobars equatorward along the coast lines.

Figure 1, which gives both the isobars and atmospheric isotherms in annual means, will help to an understanding of the phenomena in question and their causes. It will be noticed that these isotherms are greatly deflected toward the Equator along the west coasts, and that the direction in which the areas within the closed isobars are bulged or rounded out follows in general the deflection of the atmospheric isotherms on the oceans. Hence, it appears that the centers and outlines of the areas within the closed isobars depend greatly upon the air temperatures over the ocean which, as we know, are largely determined by the surface temperatures of ocean currents and drifts.

The continuous blue lines of figure 1 give the directions and locations of the cold ocean currents, and the dotted lines the directions and locations of the warm currents. It will be noticed that the marked deflections of the atmospheric isotherms toward the Equator are with the cold currents.

One of the largest and most important of these currents is the cold Antarctic drift that flows from west to east around the world at and beyond latitude 45° S. A portion of this current or drift is deflected equatorward by South America, as shown. This cold water carries the atmospheric isotherms far up the west coast toward the Tropics, and establishes a steep temperature gradient off the west coast of South America toward the Equator. Hence, marked winds from the southeast to south prevail in this region far down the coast, and are deflected counter clockwise by the rotation of the earth.

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[3] L. c.

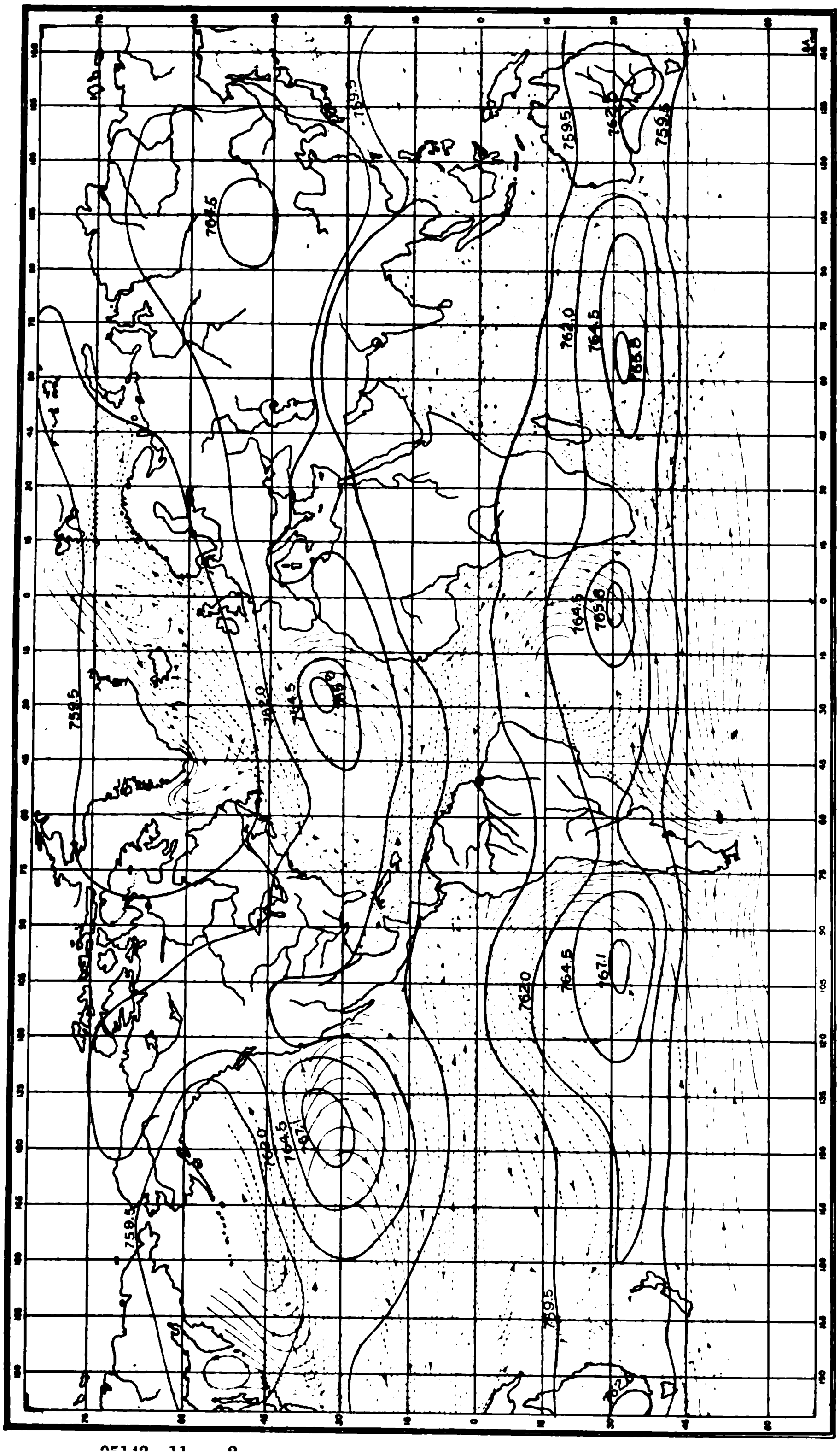

FIG. 1.—Annual average isobars (red); isotherms of air (yellow); cold ocean currents (continuous blue); warm ocean currents (dotted blue); land (black).

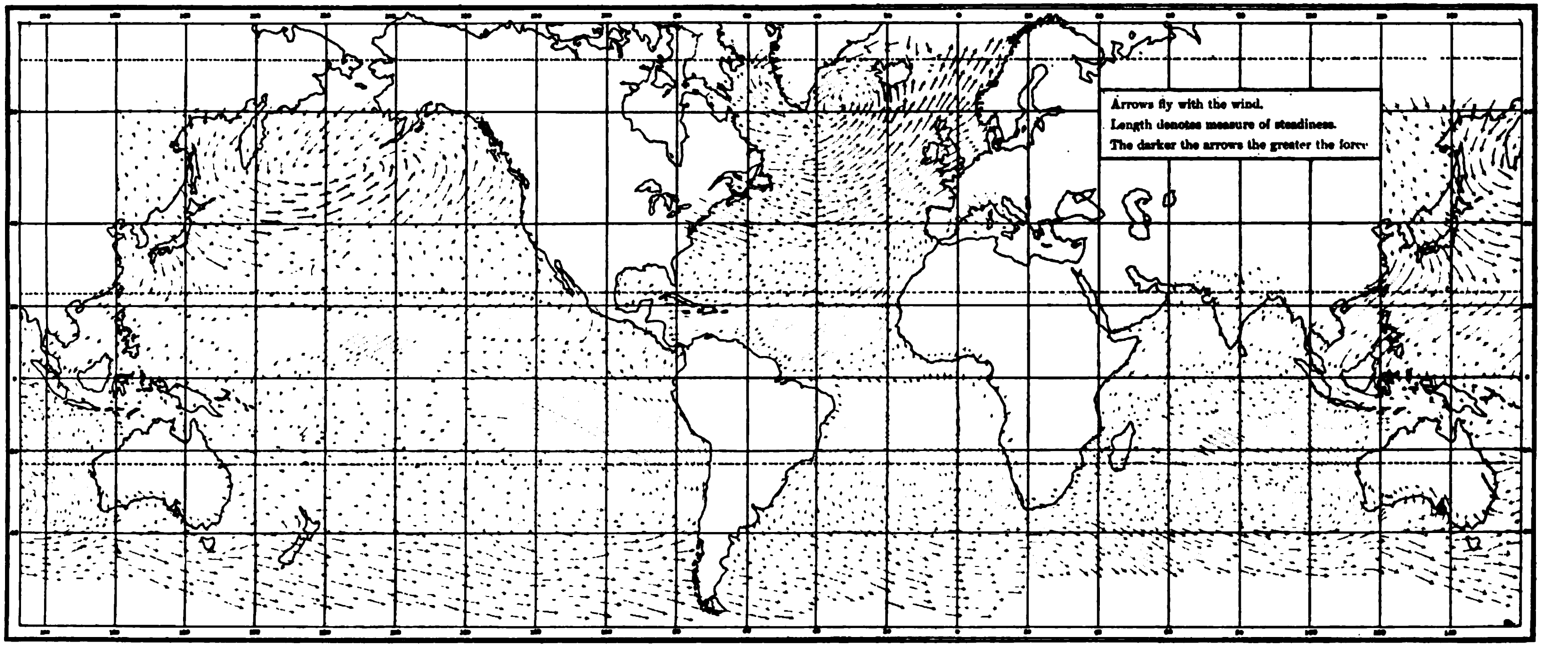
Arrows fly with the wind.
Length denotes measure of steadiness.
The darker the arrows the greater the force

FIG. 2.—Normal wind directions and velocities for January and February. The longer the arrow the more constant the wind; the heavier, the greater velocity.

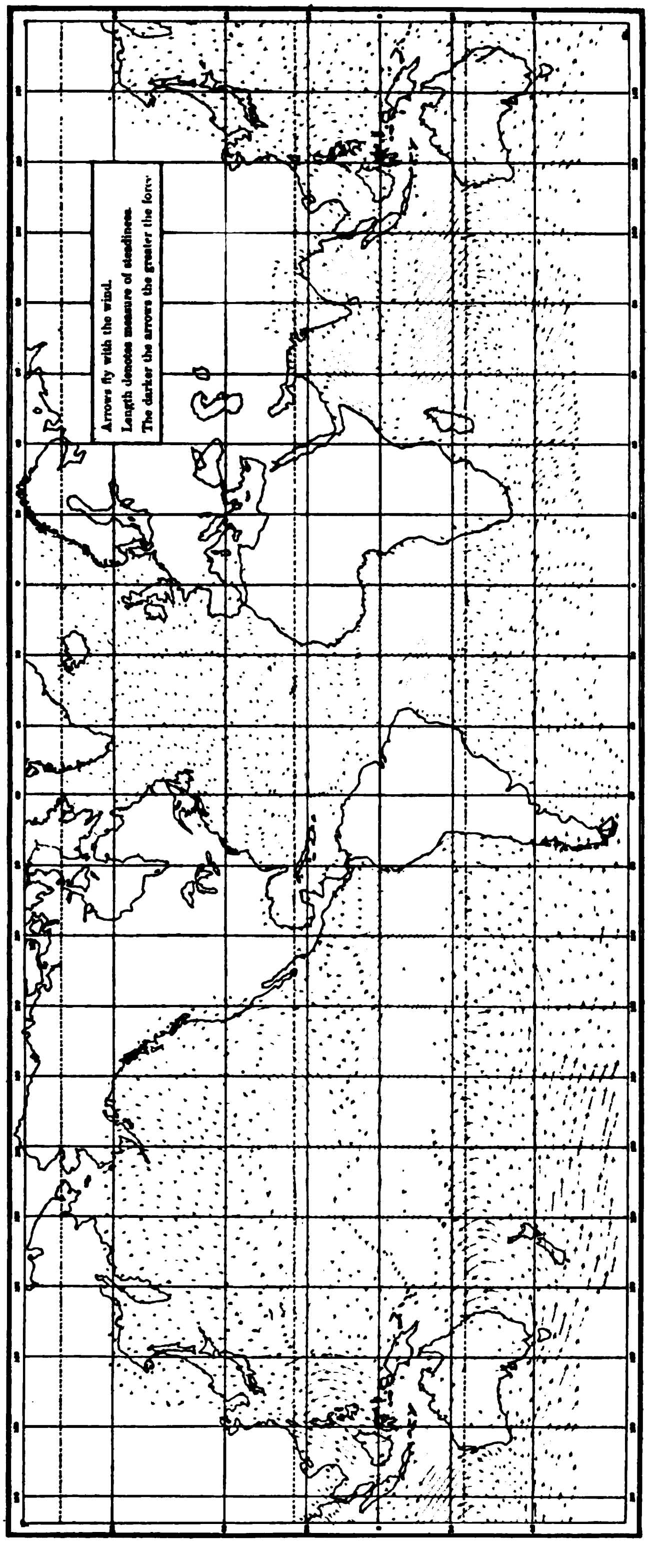
Arrows fly with the wind.
Length denotes measure of steadiness.
The darker the arrows the greater the forc

FIG. 3.—Normal wind directions and velocities for July and August. The longer the arrow the more constant the wind; the heavier, the greater velocity.

The cold water surface, because of the limited amount of heat it supplies, whether by radiation or by conduction, allows the air above it to cool to a correspondingly low temperature, and, for any given pressure, to contract and grow denser. This decreases the pressure at considerable elevations above the cold surface and allows the air to pour in from the sides, which in turn so raises the pressure at the surface of the ocean that there is a tendency for the air to flow out in all directions at the lower levels. Hence, where this cold current crosses the belt of highs, about latitude 32° S., there are two cooperating causes of high pressure: (*a*) The opposing thrusts of the eastward and westward winds, as previously explained, causing a high pressure zone and a comparative calm parallel to the Equator; (*b*) a sheet of cold water crossing this high-pressure zone from the polar to the equatorial side, which, by virtue of the cooling, increases the high at the place of crossing and thereby produces a highest center with closed isobars and gentle anticyclonic winds.

Hence, we should expect an absolute high with gentle anticyclonic winds about it wherever either zone of highs crosses a cold surface, or wherever either zone of highs is crossed by a cold ocean current, and nowhere else. Reference to figures 1, 2, and 3 will show this prediction of theory to be fully supported by the facts of observation.

It will be noticed that the areas within the closed isobars bulge out in the direction of flow of the cold ocean currents, or in the same general direction as the deflection of the isotherms, as would be expected.

It will also be noticed that the center of the anticyclone is not at the point of minimum air temperature along the zone of highs, but in every case somewhat to the west of it. This seems to be due essentially to the equatorially directed winds along the cold currents to the east of the anticyclonic centers. These winds, because of their changed direction, neither east nor west, fail to give mechanical support to the ridge of highs, which, therefore, in part gives way at this place.

A maximum ocean high, therefore, must be at that place where the mechanical and thermal causes combine to produce the greatest result; that is, a little to the west of the intersection of the coldest portion of an ocean current with a high pressure belt.

(II) THE ALEUTIAN AND ICELANDIC LOWS.

By W. J. Humphreys.

[Dated December 19, 1910.]

By referring to any good charts of the summer and winter isobars and winds of the ocean it will be seen that there is a barometric low, accompanied by cyclonic winds, near Iceland during both seasons of the year; and also that there are similar conditions in the neighborhood of the Aleutian Islands during the winter, but no trace of them in the summer time.

Ferrel[1] explains the cyclonic whirl near Iceland as due to a deflection of a portion of the west to east winds across the north Atlantic by the shores and mountains of Europe, but does not refer to the great Aleutian low of winter. He also explains, in this connection, the various oceanic highs as due to similar wind deflections. But as the centers of these highs are surrounded by outward rather than inward moving winds it appears that they can not be due wholly, if indeed in any part, to forced or mechanical disturbances caused by continents and their mountains. Hence, it seems equally improbable that either of the two great oceanic lows above mentioned is really due to the deflection of west to east winds by mountain chains, especially since each, more particularly the Icelandic, occurs on the west side of the ocean to which it belongs.

As pointed out in another paper,[2] the locations and intensities of the anticyclonic centers on the oceans are fixed by the intersection of the belts of highs with cold ocean currents. Hence, one might suspect counter effects, or cyclonic regions, in connection with the warm currents, and this indeed is just what one finds.

Naturally the warmest of the ocean currents are the broad equatorial drifts, the axes of which are located a few degrees north of the Equator on the Atlantic and Pacific Oceans, and a few degrees south of it on the Indian Ocean. This is along or close to the earth's warmest belt, which of course is everywhere a region of upward convection. But since the rotation of the earth has but little deflective effect on the winds near the Equator, and since there is no great difference of temperature from one place to another in the Tropics, therefore, no broad cyclonic whirls, analogous to those of the higher latitudes, can occur over any current near the equator.

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[1] Recent Advances in Meteorology, p. 224.

[2] Origin of the Permanent Ocean Highs, p. 1 of this bulletin.

Apart from the equatorial drifts there are only two warm currents of any great extent, namely: The Gulf Stream drift that bathes the shores of Iceland and the British Isles and flows on beyond Norway, and the Kuroshiwo, or Japan current, that fans out in the northern Pacific though to a much less extent than does the Gulf Stream in the Atlantic.

Obviously the temperature of the atmosphere over the high mountains and tablelands of Greenland and Iceland must be lower than that of the free air at the same levels above the neighboring Gulf Stream drift. Hence, there must exist a nearly continuous atmospheric overflow from above the ocean onto these two land areas and a drainage in turn from them to the water. Such a circulation, though consisting (owing to the general circulation) of frequently renewed masses of air, would of course be counter clockwise over the water, and could fully account for the cyclonic movement, even when mild, of the winds on both sides of Iceland, the southwest, especially, and northeast.

Conditions quite analogous to the above exist near the Aleutian Islands in winter, due, not to these islands themselves, but to the atmospheric circulation from high above the relatively warm water surrounding them to the excessively cold neighboring regions of Alaska and Siberia, and thence back along lower levels to the water.

In the summer, however, both Siberia and Alaska are comparatively warm, the former especially, and therefore at this time of the year a persistent Aleutian cyclone can not exist.

The high regions of Greenland and Iceland are perpetually ice covered and perpetually cold. Hence at their level the air is, in general, warmer over the intervening ocean than over the land, and therefore the Icelandic low, though varying in intensity, persists from season to season and from year to year. On the other hand, the Siberian and the Alaskan peninsulas, since their elevation is small, are relatively warm during one portion of the year, though cold and ice covered at another. The Aleutian low, therefore, is a phenomenon of the winter only and wholly disappears during the summer, when the land-to-ocean temperature gradient is reversed.

The Icelandic low is perpetual, but the Aleutian is only a seasonal phenomenon, because the horizontal temperature gradients, to which they are due, are, in the first case, of constant sign, but in the second reversible, as and for the reasons explained.

(III) VERTICAL TEMPERATURE GRADIENTS AND CONVECTION LIMITS.

By W. J. Humphreys.

[Dated April 10, 1911.]

A typical vertical temperature gradient, a composite of 117 actual gradients, winter and summer, is given by the continuous curved line of figure 1. The branches near the surface show probable morning and afternoon conditions, such as are often found. The straight line is the dry air adiabat that crosses the actual gradient at an elevation of 5.5 kilometers. The broken line is the corresponding saturation adiabat. The wavy and dotted lines between the morning and evening branches will be explained later.

Below the point of intersection the adiabats depart with increasing rapidity from the true average gradient, and reach the earth at temperatures distinctly higher than the average of those that actually obtain. The consequences of these departures are important and the phenomenon therefore deserves as well as needs explanation.

Since the surface of the earth is stongly heated by solar radiation therefore, in general, the atmosphere must rise by convection, though this motion is neither continuous nor uniform, and cool through expansion till it reaches that temperature below which the absorbed solar and terrestrial radiation will not allow it to go—the temperature of the isothermal region. From the level at which this condition is reached upward, as far as explored, the atmosphere remains at approximately the same temperature because the radiation it receives is substantially independent of elevation.

Below the isothermal region, or from about 11 kilometers down to about the level of 4 kilometers, the change in temperature with elevation, while not very different from the adiabatic, still everywhere is less than that rate, due to the fact that throughout this region gain of heat by absorption is somewhat greater than its loss from radiation. Below 4 kilometers the rate of increase of temperature, as the surface is approached, rapidly decreases. Near the surface it often happens, especially in the mornings, that instead of the temperature getting warmer with descent it actually gets colder.

Let the temperature distribution be whatever it may in the late afternoon, such as that indicated by figure 1. It commonly will be this or something approximating to it. During the night, especially when the sky is approximately clear, the surface of the earth will rapidly cool by radiation and the air for some distance above will also grow colder, largely by radiation but partly by contact with the earth either directly or indirectly through other already cooled air. By early morning the temperature distribution will be similar to that assumed in the left-hand or morning curve of figure 1.

Immediately after sunrise the surface of the earth and the air in contact with it begin to warm, and convection sets in. The first convection, since the air must cool approximately along a dry adiabat, can rise to only a small elevation, but in this way the surface layers are so warmed that each succeeding convection can rise higher than the one before it. This process is indicated by the wavy lines of increasing length in the enlarged detail. (See the upper diagram of figure 1.) After a time the convection probably will extend high enough to cause condensation, as indicated by the dotted portions of the convection or wavy lines.

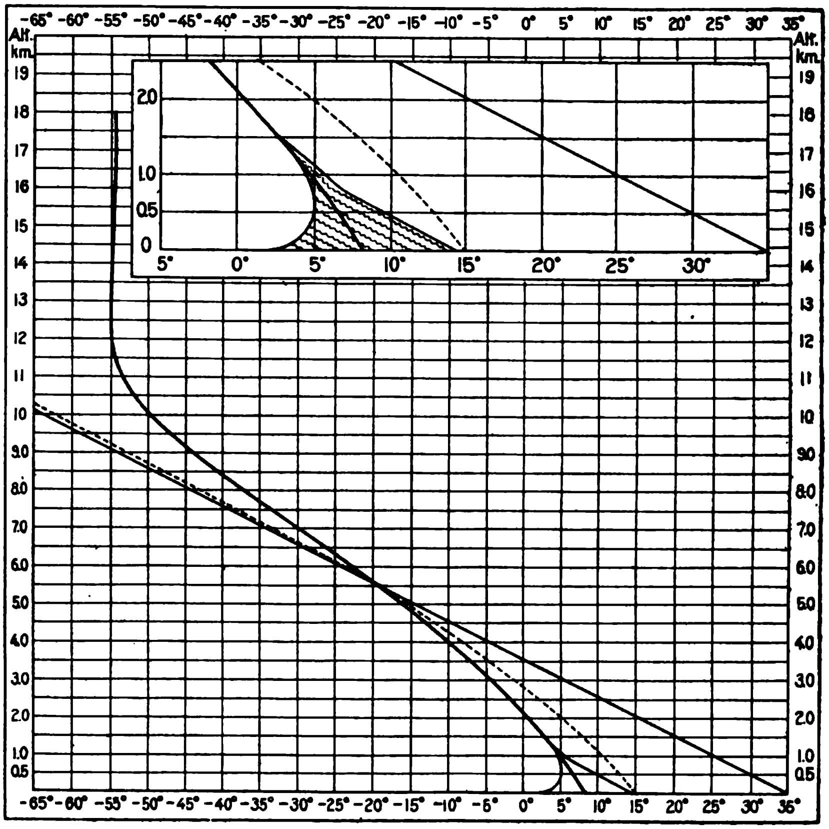

FIG. 1.—Typical vertical temperature gradients.

In this way the cooling of each night is obliterated, chiefly through convection, before sundown of the following evening, when of course cooling sets in again and the whole process is repeated. The average gradient, since it is a composite of all gradients, falls about midway between the morning and evening, or extreme gradients, and hence departs more and more from the adiabats—the limit, under ordinary conditions, of the evening gradient—as the surface of the earth, where the cooling is greatest, is approached.

The seasonal change in the temperature gradient is analogous to the daily change, but is greater both in range and height.

From the figure, it clearly appears that local convection can seldom rise to great elevations during mornings, nor, in winter, during any part of the day. Hence, cumuli, which are due to convection currents of considerable elevation, are most frequent during summer afternoons.

CONCLUSION.

By day the surface layer of air is warmed mainly by contact with the heated earth, and the layers next above it by convection. Hence the afternoon temperature gradient must closely follow first the dry air and then the saturated adiabat. By nights the lowest air is cooled by contact with the relatively cold earth, and the layers next above partly through indirect contact with the earth and partly by radiation, and thus an inversion gradient is often produced near the surface. Hence the average gradient departs more and more widely from the adiabats as the surface is approached. Hence, also during mornings, local convections usually are too shallow, but during summer afternoons quite sufficient to produce cumulus clouds.

(IV) LEVELS OF MAXIMUM AND MINIMUM CLOUDINESS.

By W. J. Humphreys.

[Dated May 1, 1911.]

INTRODUCTION.

When the frequency of clouds, or visible condensation, is tabulated with reference to elevation, maxima and minima are invariably found. They are also arranged in essentially the same order in all parts of the earth, though in general the atmospheric layers to which they pertain grow thicker as the Equator is approached.

These different levels or regions of maxima and minima of condensation are more or less generally recognized. Thus, Hann[1] and Arrhenius,[2] for instance, both recognize two levels of maximum condensation, the cumulus and the cirrus, and one of minimum condensation about half way between the two maxima.

ARRHENIUS' THEORY.

Arrhenius[3] says that the existence of the two maxima depends upon the mode of formation of the clouds, since the cumuli may be regarded as the product of a primary, and the cirri as that of a secondary condensation.

He does not, however, at least not in this connection, explain what he means by a primary and a secondary condensation. Presumably, though, by primary condensation he means that condensation which takes place on dust particles immediately ordinary saturation is passed, and by secondary condensation that condensation which takes place in dust-free ionized air at and beyond about fourfold supersaturation.

It is quite true, as first shown by C. T. R. Wilson,[4] that both positive and negative electrons serve as nuclei for condensation, but, as he also showed, it will not begin on the negative ions at less than about a fourfold supersaturation, nor on the positive at less than a sixfold supersaturation.

This theory of the two layers of maximum cloudiness, the cumulus and the cirrus, seems to presuppose an abundance of free ions, but absence of dust, above the level of about 6 kilometers, and also that supersaturation frequently exists above this level.

---

[1] Lehrbuch der Meteorologie, p. 210, 1906.

[2] Lehrbuch der kosmischen Physik, p. 649, 1903.

[3] L. c.

[4] Phil. Trans., A., p. 265, 1897.

It appears probable, however, that meteors and violent volcanic eruptions must keep this region more or less supplied with dust. Then, too, the records of sounding balloons show that even approximate first-order saturation is unusual in that region of minimum cloudiness that lies between the cumuli and the cirri.

These are not the only objections that can be urged against the theory of primary and secondary condensation, but they are sufficient to justify an attempt to find some other explanation of the origin of levels of maximum and minimum cloudiness.

GENERAL DISCUSSION.

In what follows, the different levels of maximum cloudiness and regions of minimum condensation will be taken up separately, since to each belongs its own explanation, different from and essentially independent of any of the others.

Fog level.—A sharp distinction between cloud and fog, that would enable one always to say which is which, does not seem possible, but in general a fog differs from a cloud essentially in its location and mode of formation. Both are due to the cooling of the atmosphere to a temperature below its dew point; but in the case of the cloud this cooling is generally due to expansion, and hence the cloud, except on mountain tops, is nearly always detached from the earth. Fog, on the other hand, results mainly from contact cooling, or, more exactly, through the mixing of relatively warm moist air with air that has been chilled through contact with cold surfaces. Now, at night the surface of the earth cools by radiation and, when there are no winds, the air next to the surface becomes correspondingly cold, and thus in condition to produce a fog, provided the air just over the surface, or brought to it from elsewhere, is sufficiently moist. In the same general way fogs are formed when a warm moist wind blows over a surface of snow, and also when cold air comes in contact with a relatively warm surface of water.

All these fog conditions pertain to only the bottom layer of the atmosphere. At an elevation of 500 meters the chilling effect of the cold surface generally is small, and the air too dry and warm to permit condensation as a result of convection to this level from the surface.

Hence the surface of the earth, because of the fogs due to its low temperature, is itself a level of maximum condensation.

Cumulus level.—The level of the cumulus cloud is not sharply defined—its thickness alone often amounts to more than a kilometer—but the region in which the average cumulus begins to form is between the levels of 1 and 2 kilometers above the surface.

These clouds are due to rather violent convections incident to heated surface layers of atmosphere, and therefore are most numerous during summer afternoons. On first consideration it might seem probable, when a warm mass of air is started up, that it would continue till it reached the limits of the atmosphere, and hence some explanation is necessary to show why the average cumulus level is at so small an elevation.

A better understanding of the essential cause of this phenomenon can be had by reference to figure 1 of Article III, in which the full line is a typical temperature gradient, a composite of 52 winter and 65 summer gradients obtained at Munich, Strassburg, Trappes, and Uccle. The branches near the surface indicate presumable early morning and sultry afternoon temperature distributions. The straight line gives the dry air adiabat that crosses the actual gradient at a level of about 5.5 kilometers, and the dotted line the corresponding adiabat for saturated air. The important point to note is the fact that the adiabats reach the surface at temperatures decidedly higher than that which ordinarily obtains. The reason for the differences between these several surface temperatures need not at present be explained. It is given in the preceding article.

Obviously when rapid convection takes place the temperature gradient will approximately follow the dry adiabat till the dew point is reached, and from that level on it will roughly follow the adiabat of saturation. Hence, the air that is being buoyed up quickly reaches a temperature below, and a density greater, than that of the surrounding atmosphere; as a result of this fact, those convections from restricted areas—i. e., those that produce cumulus clouds, are quickly brought to rest. Naturally there is considerable range in the altitudes reached. During the early forenoon, convection ordinarily will extend upward but a short distance, probably less than 100 meters at first. Each successive convection, however, mixes more or less warm air with the cooler air above, and thus prepares the way for the next following convection to reach a greater elevation. In general then, each convection reaches a higher level than did the one just previous. But as the heated air near the surface of the earth, air that is about to be buoyed up, generally lacks a good deal of being saturated, therefore cumulus clouds are infrequent during forenoons or other times when convection ordinarily is limited to one kilometer or less, but are numerous when, and only when, convection reaches elevations (generally 1 to 2 kilometers) sufficient to reduce the temperature of the rising air below the dew point. The warmer the season and the dryer the air, such as obtains over deserts on summer afternoons, the stronger the convections and the higher the clouds.

The cumuli, however, are not the only clouds of this level, for the same causes determine the height at which clouds begin to form in all storm areas, large or small.

The above facts then explain the existence of a level of maximum condensation, in the form of cumuli and lower storm clouds, at roughly 1.5 kilometers elevation.

Cirrus level.—The third and only other level of distinct maximum cloudiness is roughly 8 to 10 kilometers above the surface, and is characterized by cirrus clouds.

When convection has been long continued and much of the rising air itself simultaneously carried to colder latitudes, as happens in a well-developed storm, much greater elevations are reached than usually is the case when the disturbance is merely local. Under these conditions the rising air is not arrested until it reaches the isothermal layer, where, since it can go no higher, it is forced to spread out, just as warm air that has risen in a room spreads out under the ceiling. Besides, it is still further distributed by the winds which at this elevation are swifter than anywhere else.

The temperature of this region, when cirrus clouds are being formed, averages about –50° C., and as not much moisture is left, therefore, only thin clouds, and they of ice crystals, can be formed at the cirrus level.

It is practically certain that during these high convections clouds are formed throughout intermediate levels, or from the cirrus down to the lowest clouds; but the lowest nearly always obscure the intermediate. Besides the intermediate do not cover so great a territory as do the cirrus, because, as above explained, the latter are spread out under the isothermal layer, and also carried to great distances by the swift winds just beneath this layer.

The cirrus, therefore, largely because of its greater extent, is a level of maximum cloudiness.

We have now to consider the regions of minimum cloudiness.

Scud region.—As explained above, one level of maximum condensation is at the surface of the earth and another at 1.5 kilometers elevation, or thereabouts. Hence, somewhere between these two maxima there necessarily must be a minimum. But as the height of the second maximum is less, according as the relative humidity is greater, therefore minimum condensation must take place just above the fog layer, or from 100 to 300 meters above the surface.

The name "scud region" has been selected for this first region of minimum condensation because that form of cloud known as "scud," and that alone, belongs especially to this level.

Alto-stratus region.—Since the cumulus and the cirrus both are levels of maximum condensation, it follows, as above, that between these also there must be a region of minimum cloudiness. As already stated this is from 4 to 6 kilometers above the surface and hence above the level of the average cumulus. It is a region of minimum cloudiness because generally it is beyond the reach of local convection, and because such clouds as are formed here are not spread out over so great a territory as are the cirri, which often float at the very top of possible convection and where the winds are swiftest.

Isothermal region.—Convection can not appreciably extend into the isothermal region for the obvious reason that a mass of air rising into this region would, through expansion, quickly become cooler and denser than the surrounding atmosphere. Hence such moisture as this region contains must be there chiefly through diffusion, but as the temperature seldom is above −50° C., the absolute humidity must be excessively minute. Moreover, this temperature is subject to marked changes, dropping at times to as low as −70° C., and as even this latter temperature apparently does not produce clouds in the isothermal region, it would appear that its supply of moisture must be exceedingly small, assuming, of course, the presence of meteoric dust in quantity sufficient for the necessary nuclei.

If a name should be assigned to this region which, like the suggested names of the other levels, would indicate the type of cloud most peculiar to it, one might select "noctilucent region," since noctilucent clouds are the only kind ever reported at considerable distances above the cirrus level. However, such clouds have not been seen for several years, and, besides, it is not certain that they were clouds at all in the ordinary sense; that is, innumerable minute portions of condensed moisture. Hence, "isothermal" probably is a better name than "noctilucent."

CONCLUSION.

At middle latitudes the levels of maximum condensation are roughly:

1. *Fog level*, surface of the earth or water.
2. *Cumulus level*, 1 to 2 kilometers above the surface.
3. *Cirrus level*, 8 to 10 kilometers above the surface.

The corresponding approximate levels, or, preferably, regions of minimum condensation, are:

1. *Scud region*, 100 to 300 meters elevation.
2. *Alto-stratus region*, chiefly 4 to 6 kilometers above the surface.
3. $\left\{\begin{matrix}\textit{Isothermal}\\ \textit{Noctilucent}\end{matrix}\right\}$ *region*, usually 11 kilometers and more above the surface.

(V) A BAROMETRIC WAVE IN KANSAS.

By T. B. JENNINGS.

I have the honor to inclose herewith copies of the barograph trace sheets for the night of February 13–14, 1909, showing a barometric disturbance that apparently moved northeastward across the eastern portion of the State that night.

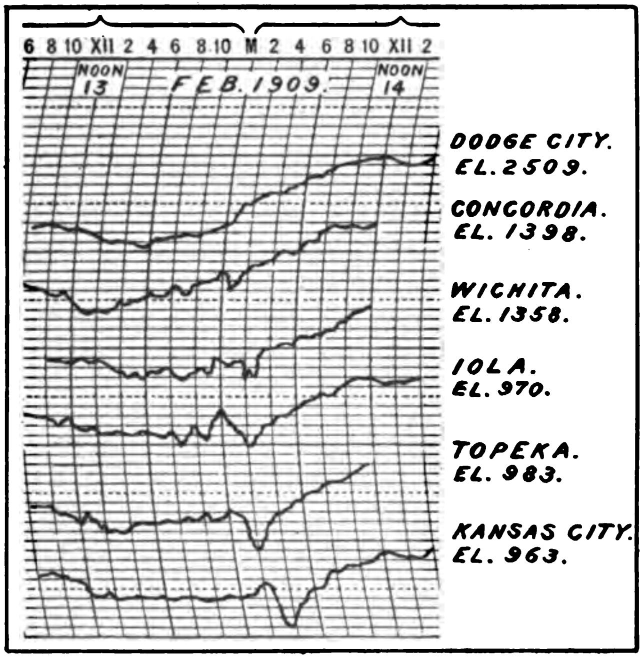

FIG. 1.

These curves (see fig. 1 herewith) show the conditions recorded by barographs at the following altitudes in feet: Dodge City, 2,509; Concordia, 1,398; Wichita, 1,358; Iola, 970; Topeka, 983; all in Kansas; and at Kansas City, Mo., 963.

The author hopes that this note may stimulate the study of such barometric disturbances.

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Part 2

OF THE

MOUNT WEATHER OBSERVATORY

PREPARED UNDER THE DIRECTION OF

WILLIS L. MOORE, D. Sc., LL. D.

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STAFF OF THE
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Consulting Physicist	William J. Humphreys, Washington, D. C.
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BULLETIN

OF THE

MOUNT WEATHER OBSERVATORY.

Vol. IV. January, February, March, 1911. Closed May 31, 1911.
Part 2. CLEVELAND ABBE, Editor. Issued Sept. 20, 1911.

(VI) SUMMARY OF THE FREE AIR DATA AT MOUNT WEATHER FOR THE THREE YEARS, JULY 1, 1907, TO JUNE 30, 1910.

By the Aerial Section—WILLIAM R. BLAIR in charge.

(Dated May 20, 1911.)

On 980 of the 1,096 days of this period, 1,013 ascensions were made. The meteorograph was carried up by kites 896 times and by captive balloons 117 times. Occasionally two observations were made on the same day, but during the first two years no observations were made on Sundays. Air temperature, air pressure, and wind direction aloft were observed, in addition to noting weather conditions and keeping the usual continuous meteorological records at the earth's surface.

The air-pressure data have been used only in the determination of altitudes.

The temperatures observed on these 980 days have been grouped by months and by seasons, and means have been computed for levels 250 meters apart up to 7,250 meters above the sea level. In these means each day's observations have been given the same weight. The observations are well distributed throughout their respective periods, and the means for each group fairly consistent up to and including the 4,500 meter level. Above this level the distribution of the observations is not good and the means have little weight.

Tables I and II show these mean free air temperatures above Mount Weather. Table I gives the monthly means and Table II the seasonal and annual means. Under each month in Table I are three columns. The first contains the number of observations or weights of the means; the second, the mean free-air temperatures, and the third, the mean change in temperature per 100 meters. A similar arrangement obtains in Table II.

Figure 1 was constructed from the data in Table I as follows: The mean temperature gradient for each month was plotted and the altitude of the even degrees of temperature transferred from these plots to figure 1. Through all points indicating the same temperature a curve was drawn. Any point on any 2n degree curve shows the altitude at which the three year mean temperature for 30 days, 15 before and 15 after the date of the point in question, is 2n degrees. According to these lines of mean temperature, the yearly maximum occurs in July at the surface and in August at 4,500 meters above sea level. At the surface the rise of the temperature before the maximum is reached and the subsequent fall are quite symmetrical, while at higher levels the fall is considerably more rapid than the rise. At the surface the means for December, January, and February are practically equal. At higher levels there is a decided maximum in January with minima in December and February.

In the miscellaneous Table III are given the available data more or less directly related to the temperature data. All data in Table III are for the three years, except those items marked with an asterisk (*), which are for only the last two years of the period.

The value of these three year monthly means as normals depends on whether or not the three years in which the data were collected are average years and on the distribution, monthly and diurnal, of the observations, i. e., aside from observational and instrumental inaccuracy.

Table III shows, in the first line, the mean surface temperature of each month for the three years at Mount Weather; in the second line these means are given as reduced to a 38-year period by comparison with the temperature observations at Washington and Lynchburg. At both of these stations the winter temperatures of the short period have been high and the summer temperatures low as compared with those of the long period. The annual correction to be applied to the short period, −0.2°, is small. The data in lines 10 to 17, Table III, have to do with the peculiarities of the period, e. g., the mean surface wind velocities for December and February are higher than those for January and the mean direction is considerably farther to the north of west. The January mean temperatures need larger negative corrections at the surface and, in all probability, at the higher levels, than those of either December or February. These data will become more interesting as those for other years are compared with and included in them. The weights of the means given in lines 14 to 17 may be found in Table I.

The distribution of the observations in any month is fairly good up to the 4,500-meter level, though, of course, better at the lower than at the upper levels.

The diurnal distribution of the observations is not so good. Considering the time at which the highest point was reached in any ascension as the time of observation, all observations are included in the hours 6:30 a. m. to 10:29 p. m. If all observations from 6:30 a. m. to 7:29 a. m. be called 7 a. m. observations; those from 7:30 a. m. to 8:29 a. m. be called 8 a. m., etc., there will be found two maxima in the number of observations, one occurring at about 10 a. m. and the other between 3 and 4 p. m. The minimum number is at 1 p. m. The sixth and seventh lines of Table III show the percentage of observations made from 6:30 a. m. to 12:29 p. m., and the mean time at which they were made. The eighth and ninth lines contain similar data for the observations made from 12:30 to 10:29 p. m. The times of observation are a little too late in the forenoon and too early in the afternoon to represent average conditions. This is especially true of the summer months, although, as the fourth line of Table III shows, the mean monthly differences between the surface temperatures taken from the kite meteorograph, line 3, and the means for the station, line 1, are not as much as 1°. The mean correction to be applied to the kite temperatures at the surface for the months May to September is $-0.8°$, and for the rest of the year $-0.3°$. This correction is largely, if not entirely, attributable to the fact that the temperatures observed with the kite meteorograph were, in point of time, a little too near the diurnal maximum, especially in the summer months. Since the diurnal range of temperature decreases with altitude, rapidly in the first 1,000 meters and less rapidly above this level, the corrections to be applied at any level above the surface are considerably less than those for the surface given in line 4, Table III.

The data so far collected do not enable us to determine accurately these corrections, owing to the diurnal variation in temperature to be applied above the surface, but at the 1,000-meter level the corrections are probably not over half those at the surface, i. e., less than half a degree at the most and less than one-fourth of a degree on the average. All of these corrections are small, i. e., entirely within the error of observation, except those at the surface and probably up to the 1,250-meter level for the months of May to September. Tables I and II contain means of the observed temperatures without correction, and, with the exception just noted, the value of these means as normals is directly related to the number of observations and the period in which they were taken.

The free air temperatures and wind directions of the period have also been grouped and reduced as described in this bulletin (Vol. II, pt. 3, pp. 145 to 147) in connection with the summary of the first year's observations. There are now 333 observations in the first group, 188 in the second, and 386 in the third; 73 observations made well within high-pressure areas are not included in the first group because the directions of motion or the locations of the centers of the high-pressure areas in question were indeterminable. Another subgroup has been introduced in the third group of observations to include those made when a low-pressure area was moving up the Atlantic coast.

It will be recalled that the surface air pressure reduced to sea level was above 764.5 millimeters in the first group, below 759.5 millimeters in the second group, and between these two pressures in the third.

The number and distribution of the temperature observations in the three groups is such as to warrant the publication in tabular form of the mean free-air temperatures above Mount Weather at levels 250 meters apart up to 7,250 meters above sea level, by seasons and quadrants in the first two groups and by seasons in the third. (See Tables IV, VI, and VIII, respectively.)

Tables V and VII show the mean free air temperatures at different levels above Mount Weather, arranged by seasons, in the front and in the rear of high and low pressure areas, respectively. With each column of mean temperatures in any table, IV to VIII, is one column showing the weight of the mean and another showing the mean change in temperature per 100 meters of altitude.

In each of the three groups above described about 62 per cent of the observations were made in the forenoon at the average time $10^h\ 10^m$, and 38 per cent in the afternoon at the average time $3^h\ 30^m$.

Figures 2 to 5, 6 to 9, and 10 to 12 are, respectively, graphic representations of the data in Tables IV, VI, and VIII. To the right and at the foot of each curve in these figures is the number of observations represented in the mean, while below is the temperature of the point common to the curve and the base line. The curves in figures 2 to 12 are smoother than those in figures 26 to 35, this bulletin (Vol. II, pt. 3), but show the same general characteristics. In high-pressure areas up to about the 2,000 meter level the vertical temperature gradient is small or inverted in the winter months, but is large in the summer months. The spring and autumn gradients in these levels are intermediate in dimension between the other two seasons and, up to the 1,000-meter level, are decidedly larger in the front than in the rear of high-pressure areas, in the rear than in the front of low-pressure areas.

The statements I, 3, for cyclone, and II, 3, for anticyclone, on page 157 of this bulletin, Vol. II, pt. 3, are well borne out by the spring, autumn, and winter observations of temperature, especially so in the last-named season. The means of the summer observations do not show a greater change in temperature with altitude over rising surface air pressure than over falling. This may be accounted for, in part at least, by: (1) The heating of the surface stratum in the clear weather accompanying rising surface air pressure is greater in proportion to the insolation in the summer than in the winter months. (2) The starting point of the surface air currents is farther above the earth's surface in the summer than in the winter months.[1] This gives more time for adiabatic heating in the descending cold-air column to check the descent of the column. (3) The ascending currents are of comparatively small velocity near the earth's surface in the summer months, though at no great altitude their velocity may become comparatively great. The greater uniformity of surface-air temperatures and pressures of the summer months may be accounted for by the same facts.

In stating the conclusions drawn from the summary, referred to above, of the first year's data,[1] the second paragraph would be more consistent with the first if the third and seventh lines of the paragraph read "the descending current in front of the anticyclone's center, etc.," and "the ascending current in front of the cyclone's center, etc.," respectively. Other statements in that article referring to vertical circulation in the atmosphere should agree with these. The importance of making this distinction did not occur to the writer until some months later. (See Vol. II, pt. 5, p. 312, this bulletin.)

Figures 13 to 20 show the means of the wind directions observed in high-pressure areas at the surface and at higher levels. The number of observations included in any mean is indicated to the left of the arrow representing that mean. Figures 21 to 25 show the corresponding wind observations in low-pressure areas. The number of observations is indicated as in figures 13 to 20. Tables IX to XIV show those wind observations made during the last two years of the period July 1, 1908, to June 30, 1910, when the surface-air pressure reduced to sea level was more than 759.5 and less than 764.5 millimeters of mercury. Wind observations in this group for the first year have appeared on pages 148 to 150, Volume II of this bulletin.

It should be recalled that the large arrow across the face of each figure, 13 to 25, represents the direction of motion of the high or low pressure area in which the observations were made. Of all high-pressure areas in which observations were made during this three-year period, 2 per cent were moving north, 8 per cent northeast, 10 per cent east-northeast, 34 per cent east, 18 per cent east-southeast, 13 per cent southeast, and 15 per cent south at the time of the observation. Of the low-pressure areas, the percentages moving in these directions were 3, 32, 22, 35, 3, 4, and 1, respectively. The octants were always numbered with reference to the direction of motion of the disturbance. The directions of motion were superposed and the means, shown in figures 13 to 25, taken. Tables XV and XVI supplement figures 13 to 25, Table XV for high-pressure areas and Table XVI for low. The angle between any arrow showing mean wind direction in the above figures and the tangent, at the point of the arrow, to a circle about the center of the high or low pressure area represented may be found in these tables. In Table XV, if an arrow has a component toward the center of the high-pressure area, the angle it forms with the tangent at its point is negative. In Table XVI, if an arrow has a component away from the center of the low, it forms a negative angle with the tangent at its point. The change in sign from minus to plus in Table XV, and from plus to minus in Table XVI, at the boundary line between the sixth and seventh octants, is marked.

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[1] This bulletin, Vol. II, pt. 2, p. 73.

By thinking of the red arrows, figures 13 to 25, as tangent to the lines of flow of the air about centers of high or low pressure, one is able to follow these lines in a general way. They seem to be fairly well-defined spiral curves at the surface. In high-pressure areas all arrows have a component in the direction of motion of the area at the 3,000-meter level. In low-pressure areas the same tendency is apparent, but the number of observations in the left half which reach the 3,000-meter level are few. Those in the left quarter reaching the 3,000-meter level were made when a hurricane was off the South Atlantic coast.

TABLE I.—*Monthly mean of free air temperatures, July 1, 1907, to June 30, 1910.*

Altitude above sea level.	January.			February.			March.			April.			May.			June.		
	Observations.	Temperature.	*Δt* per 100 meters.	Observations.	Temperature.	*Δt* per 100 meters.	Observations.	Temperature.	*Δt* per 100 meters.	Observations.	Temperature.	*Δt* per 100 meters.	Observations.	Temperature.	*Δt* per 100 meters.	Observations.	Temperature.	*Δt* per 100 meters.
Meters.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
526	83	− 1.0	......	76	− 0.2	......	81	6.3	......	80	10.9	......	83	15.6	......	82	19.8	......
750	83	− 1.3	0.12	76	− 1.0	0.32	81	5.3	0.40	80	9.3	0.64	83	14.0	0.64	82	18.4	0.56
1,000	80	− 1.5	0.08	74	− 1.9	0.36	77	4.4	0.36	75	7.9	0.56	79	12.3	0.68	80	16.9	0.60
1,250	76	− 1.8	0.12	72	− 2.6	0.28	74	3.3	0.44	71	6.6	0.52	72	10.6	0.68	73	15.4	0.60
1,500	66	− 2.1	0.12	69	− 3.3	0.28	73	2.2	0.44	69	5.3	0.52	65	9.0	0.64	65	14.0	0.56
1,750	60	− 2.7	0.24	60	− 4.2	0.36	69	1.2	0.40	64	3.9	0.56	57	7.4	0.64	59	12.5	0.60
2,000	52	− 3.6	0.36	51	− 5.0	0.32	67	0.1	0.44	57	2.6	0.52	50	5.8	0.64	50	11.2	0.52
2,250	46	− 4.3	0.28	46	− 6.0	0.40	61	− 1.0	0.44	51	1.3	0.52	43	4.3	0.60	39	10.0	0.48
2,500	40	− 5.5	0.48	37	− 7.2	0.48	52	− 2.3	0.52	42	0.1	0.48	38	2.9	0.56	30	8.6	0.56
2,750	34	− 6.6	0.44	32	− 8.0	0.32	44	− 3.6	0.52	37	− 1.0	0.44	33	1.5	0.56	25	7.2	0.56
3,000	26	− 7.9	0.52	30	− 9.1	0.44	36	− 5.0	0.56	34	− 2.3	0.52	27	0.2	0.52	24	5.7	0.60
3,250	19	− 9.2	0.52	25	−10.6	0.60	34	− 6.5	0.60	28	− 3.9	0.64	23	− 1.0	0.48	22	4.1	0.64
3,500	14	−10.5	0.52	19	−12.2	0.64	25	− 7.8	0.52	23	− 5.6	0.68	18	− 2.5	0.60	17	2.5	0.64
3,750	11	−11.9	0.56	13	−13.6	0.56	19	− 9.2	0.56	20	− 7.3	0.68	13	− 3.9	0.56	15	0.9	0.64
4,000	11	−13.2	0.52	9	−15.0	0.56	11	−10.8	0.64	19	− 8.9	0.64	9	− 5.3	0.56	9	− 0.8	0.68
4,250	10	−14.5	0.52	5	−16.5	0.60	8	−12.6	0.72	13	−10.7	0.72	6	− 6.6	0.52	5	− 2.4	0.64
4,500	8	−15.7	0.48	4	−17.9	0.56	6	−14.3	0.68	9	−12.4	0.68	4	− 8.2	0.64	3	− 3.9	0.60
4,750	5	−17.2	0.60	1	−20.2	0.92	6	−15.9	0.64	4	−13.8	0.56	2	− 9.6	0.56	3	− 5.1	0.48
5,000	5	−18.6	0.56	1	−21.4	0.48	5	−17.5	0.64	3	−15.3	0.60	1	−11.2	0.64	2	− 6.1	0.40
5,250	2	−20.0	0.56	1	−23.2	0.72	2	−18.9	0.56	3	−16.9	0.64	1	−12.8	0.64	2	− 7.3	0.48
5,500	2	−21.6	0.64	......	......	......	......	......	......	3	−18.7	0.72	1	−14.3	0.60	1	− 9.2	0.76
5,750	1	−24.5	1.16	......	......	......	......	......	......	2	−20.4	0.68	1	−15.8	0.60	......	......	......
6,000	......	......	......	......	......	......	......	......	......	2	−22.2	0.72	1	−17.3	0.60	......	......	......
6,250	......	......	......	......	......	......	......	......	......	2	−24.0	0.72	1	−18.8	0.60	......	......	......
6,500	......	......	......	......	......	......	......	......	......	2	−25.7	0.68	1	−20.2	0.56	......	......	......
6,750	......	......	......	......	......	......	......	......	......	2	−27.4	0.68	1	−21.6	0.56	......	......	......
7,000	......	......	......	......	......	......	......	......	......	1	−28.8	0.56	1	−22.9	0.52	......	......	......
7,250	......	......	......	......	......	......	......	......	......	......	......	......	1	−24.2	0.52	......	......	......

Altitude above sea level.	July.			August.			September.			October.			November.			December.		
	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.
Meters.		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*
526	83	22.3	......	84	21.1	......	81	18.1	......	85	10.8	......	81	6.8	......	81	− 0.2	......
750	83	20.7	0.64	84	19.7	0.56	81	16.9	0.48	85	9.5	0.52	81	5.9	0.36	81	− 1.5	0.52
1,000	80	19.0	0.68	83	18.2	0.60	77	15.8	0.44	83	8.3	0.48	81	4.9	0.40	81	− 2.3	0.32
1,250	77	17.4	0.64	80	16.8	0.56	73	14.6	0.48	77	7.1	0.48	75	3.9	0.40	75	− 2.8	0.20
1,500	73	15.8	0.64	73	15.4	0.56	68	13.3	0.52	74	6.1	0.40	69	2.9	0.40	68	− 3.1	0.12
1,750	65	14.2	0.64	65	14.0	0.56	59	12.2	0.44	65	5.0	0.44	59	1.9	0.40	63	− 3.6	0.20
2,000	54	12.7	0.60	59	12.6	0.56	55	11.1	0.44	60	4.1	0.36	59	1.0	0.36	56	− 4.4	0.32
2,250	41	11.3	0.56	41	11.4	0.48	39	10.1	0.40	53	3.3	0.32	51	0.0	0.40	50	− 5.3	0.36
2,500	32	9.9	0.56	30	10.1	0.52	28	9.0	0.44	50	2.3	0.40	44	− 1.1	0.44	44	− 6.3	0.40
2,750	24	8.5	0.56	22	8.8	0.52	23	7.7	0.52	38	1.2	0.44	38	− 2.4	0.52	37	− 7.3	0.40
3,000	21	7.1	0.56	17	7.1	0.68	20	6.3	0.56	31	0.0	0.48	34	− 3.9	0.60	31	− 8.6	0.52
3,250	17	5.5	0.64	16	5.6	0.60	16	4.7	0.64	23	− 1.3	0.52	26	− 5.1	0.48	23	−10.1	0.60
3,500	16	3.8	0.68	12	4.3	0.52	14	3.3	0.56	16	− 2.6	0.52	21	− 6.5	0.56	17	−11.6	0.60
3,750	15	2.2	0.64	11	3.0	0.52	9	1.8	0.60	15	− 3.9	0.52	16	− 8.1	0.64	9	−13.2	0.64
4,000	12	0.7	0.60	9	1.5	0.60	6	− 0.1	0.76	13	− 5.1	0.48	12	− 9.6	0.60	5	−14.6	0.56
4,250	9	− 1.0	0.68	6	− 0.2	0.68	4	− 1.5	0.56	12	− 6.5	0.56	11	−11.2	0.64	2	−16.0	0.56
4,500	6	− 2.5	0.60	3	− 2.2	0.80	3	− 2.7	0.48	11	− 8.1	0.64	10	−12.9	0.68	2	−17.6	0.64
4,750	4	− 3.9	0.56	1	− 4.5	0.92	1	− 4.4	0.68	9	− 9.9	0.72	9	−14.6	0.68	1	−19.6	0.80
5,000	4	− 5.4	0.60	1	− 6.7	0.88	1	− 6.4	0.80	6	−12.0	0.84	7	−16.1	0.60	......	......	......
5,250	4	− 6.8	0.56	1	− 8.9	0.88	1	− 8.0	0.64	4	−14.2	0.88	5	−17.4	0.52	......	......	......
5,500	2	− 8.2	0.56	1	−11.1	0.88	1	− 8.9	0.36	3	−15.6	0.56	4	−18.8	0.56	......	......	......
5,750	1	− 9.7	0.60	1	−13.5	0.96	1	− 9.7	0.32	3	−17.0	0.56	1	−20.2	0.56	......	......	......
6,000	1	−11.2	0.60	1	−16.1	1.04	1	−11.9	0.88	2	−18.5	0.60	1	−21.7	0.60	......	......	......
6,250	1	−12.7	0.60	......	......	......	1	−14.4	1.00	1	−19.3	0.32	......	......	......	......	......	......
6,500	1	−14.1	0.56	......	......	......	1	−17.5	1.24	1	−22.2	1.16	......	......	......	......	......	......
6,750	1	−15.6	0.60	......	......	......	1	−21.0	1.40	1	−24.5	0.92	......	......	......	......	......	......
7,000	1	−17.0	0.56	......	......	......	......	......	......	1	−27.3	1.12	......	......	......	......	......	......
7,250	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......

TABLE 11.—*Seasonal and annual mean free air temperatures, July 1, 1907, to June 30, 1910.*

Altitude above sea level.	Spring.			Summer.			Autumn.			Winter.			Annual.		
	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.
Meters.		° C.	° C.		° C.	° C.		° C.	° C.		° C.	° C.		° C.	° C.
526	244	11.0	....	249	21.1	....	247	11.9	....	240	— 0.5	....	980	11.0	....
750	244	9.6	0.56	249	19.6	0.60	247	10.8	0.44	240	— 1.3	0.32	980	9.8	0.48
1,000	231	8.3	0.52	243	18.0	0.64	241	9.7	0.44	235	— 2.0	0.28	950	8.6	0.48
1,250	217	6.9	0.56	230	16.5	0.60	225	8.6	0.44	223	— 2.5	0.20	895	7.5	0.44
1,500	207	5.6	0.52	211	15.0	0.60	211	7.5	0.44	203	— 2.9	0.16	832	6.4	0.44
1,750	190	4.3	0.52	189	13.5	0.60	183	6.4	0.44	183	— 3.6	0.28	745	5.3	0.44
2,000	174	3.0	0.52	163	12.1	0.56	174	5.4	0.40	159	— 4.4	0.32	670	4.2	0.44
2,250	155	1.7	0.52	121	10.8	0.52	143	4.5	0.36	142	— 5.3	0.36	561	3.1	0.44
2,500	132	0.4	0.52	92	9.4	0.56	122	3.4	0.44	121	— 6.4	0.44	467	1.9	0.48
2,750	114	— 0.9	0.52	71	8.0	0.56	99	2.1	0.52	103	— 7.4	0.40	387	0.7	0.48
3,000	97	— 2.3	0.56	62	6.5	0.60	85	0.8	0.52	87	— 8.6	0.48	331	— 0.7	0.56
3,250	85	— 3.7	0.56	55	4.9	0.64	65	— 0.5	0.52	67	—10.0	0.56	272	— 2.1	0.56
3,500	66	— 5.2	0.60	45	3.4	0.60	51	— 1.9	0.56	50	—11.5	0.60	212	— 3.6	0.60
3,750	52	— 6.7	0.60	41	1.9	0.60	40	— 3.4	0.60	33	—12.9	0.56	166	— 5.1	0.60
4,000	39	— 8.3	0.64	30	0.4	0.60	31	— 4.9	0.60	25	—14.3	0.56	125	— 6.6	0.60
4,250	27	—10.0	0.68	20	— 1.2	0.64	27	— 6.4	0.60	17	—15.7	0.56	91	— 8.2	0.64
4,500	19	—11.7	0.68	12	— 2.8	0.64	24	— 8.0	0.64	14	—17.0	0.52	69	— 9.8	0.64
4,750	12	—13.2	0.60	8	— 4.3	0.60	19	— 9.7	0.68	7	—18.7	0.68	46	—11.4	0.64
5,000	9	—14.8	0.64	7	— 5.7	0.56	14	—11.5	0.72	6	—20.1	0.56	36	—13.0	0.64
5,250	6	—16.3	0.60	7	— 7.2	0.60	10	—13.1	0.64	3	—21.7	0.64	26	—14.6	0.64
5,500	4	—18.0	0.68	4	— 8.9	0.68	8	—14.4	0.52	2	—23.3	0.64	18	—16.1	0.60
5,750	3	—19.6	0.64	2	—10.9	0.80	5	—15.7	0.52	1	—26.2	1.16	11	—17.7	0.64
6,000	3	—21.3	0.68	2	—12.9	0.80	4	—17.4	0.68	....	....	....	9	—19.5	0.72
6,250	3	—23.0	0.68	1	—14.4	0.60	2	—19.0	0.64	....	....	....	6	—21.1	0.64
6,500	3	—24.6	0.64	1	—15.8	0.56	2	—22.0	1.20	....	....	....	6	—23.1	0.80
6,750	3	—26.2	0.64	1	—17.2	0.56	2	—24.9	1.16	....	....	....	6	—25.1	0.80
7,000	2	—27.6	0.56	1	—18.6	0.56	1	—27.7	1.12	....	....	....	4	—26.8	0.68
7,250	1	—28.9	0.52	....	....	....	....	....	....	....	....	....	1	—28.1	0.52

TABLE III.—*Miscellaneous Mount Weather data related to the temperature data in Table I, July 1, 1907, to June 30, 1910.*

		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	Mean surface temperatures	−0.7	−0.8	5.8	10.5	14.7	19.1	21.6	20.2	17.4	*10.9	6.3	−0.6
2	Corrected mean surface temperatures	−1.6	−1.4	3.4	9.1	15.1	19.7	22.0	20.9	17.8	11.9	4.0	−0.5
3	Mean surface temperatures, kite observations	−1.0	−0.2	6.3	10.9	15.6	19.8	22.3	21.1	18.1	10.8	6.8	−0.2
4	Reductions—line 1 minus line 3	+0.3	−0.6	−0.5	−0.4	−0.9	−0.7	−0.7	−0.9	−0.7	+0.1	−0.5	−0.4
5	Reductions—line 2 minus line 3	−0.6	−1.2	−2.9	−1.8	−0.5	−0.1	−0.3	−0.2	−0.3	+1.1	−2.8	−0.3
6	Per cent of kite observations in a. m	66	68	63	58	55	48	56	60	55	63	68	72
7	Mean time of a. m. kite observations	10:20	10:15	10:00	9:50	9:50	10:15	10:00	9:50	10:20	10:15	10:30	10:15
8	Per cent of kite observations in p. m	34	32	37	42	45	52	44	40	45	37	32	28
9	Mean time of p. m. kite observations	3:25	3:15	3:45	3:15	3:55	3:25	3:50	3:00	3:30	3:40	3:30	4:15
10	Mean duration of actual sunshine, in hours	145	163	229	251	282	271	321	291	254	236	178	144
11	Mean cloudiness, per cent	59	59	51	55	56	56	45	47	43	38	51	57
12	Mean surface wind velocity, m. p. s	7.8	8.7	7.8	7.6	6.3	4.9	5.1	4.5	4.9	*5.8	*7.2	*8.3
	Mean wind directions:												
13	At surface	N. 84 W.	N. 70 W.	S. 88 W.	S. 68 W.	N. 77 W.	N. 77 W.	N. 81 W.	N. 69 W.	S. 20 W.	N. 55 W.	N. 86 W.	N. 66 W.
14	At 1,000 meters	S. 83 W.	S. 80 W.	S. 80 W.	S. 65 W.	S. 66 W.	N. 85 W.	N. 84 W.	N. 74 W.	S. 63 W.	N. 68 W.	S. 88 W.	N. 76 W.
15	At 2,000 meters	N. 89 W.	S. 88 W.	N. 87 W.	S. 78 W.	S. 87 W.	N. 71 W.	N. 80 W.	N. 67 W.	N. 65 W.	N. 55 W.	N. 81 W.	N. 73 W.
16	At 3,000 meters	S. 83 W.	N. 89 W.	N. 81 W.	S. 85 W.	S. 88 W.	N. 76 W.	N. 67 W.	N. 67 W.	N. 73 W.	N. 57 W.	N. 88 W.	N. 76 W.
17	At 4,000 meters	W.	S. 76 W.	N. 77 W.	S. 78 W.	N. 72 W.	N. 74 W.	N. 71 W.	N. 73 W.	N. 89 W.	N. 77 W.	N. 79 W.	N. 80 W.

TABLE IV.—*Mean free air temperatures in highs, by quadrants and seasons, July 1, 1907, to June 30, 1910.*

Altitude above sea level.	I.												II.											
	Spring.			Summer.			Autumn.			Winter.			Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.
Meters.		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*
526	17	3.8	......	10	17.0	......	24	8.2	......	34	− 3.4	......	8	11.7	......	9	23.1	......	21	13.7	......	22	0.4	......
750	17	1.8	0.89	10	15.9	0.49	24	6.9	0.57	34	− 4.8	0.62	8	11.8	−0.04	9	21.5	0.70	21	12.8	0.40	22	0.0	0.18
1,000	16	− 0.1	0.76	10	14.6	0.52	24	5.6	0.52	34	− 5.8	0.40	8	10.8	0.40	9	19.2	0.92	20	12.1	0.28	22	− 0.3	0.12
1,250	15	− 1.1	0.40	9	13.3	0.52	23	4.1	0.60	34	− 5.8	0.00	7	9.3	0.60	9	17.8	0.56	19	11.2	0.36	21	− 0.2	−0.04
1,500	15	− 1.8	0.28	8	12.6	0.28	21	3.2	0.36	33	− 5.9	0.04	7	7.8	0.60	8	16.1	0.68	18	10.0	0.48	20	− 0.5	0.12
1,750	15	− 2.6	0.32	8	11.4	0.48	20	2.2	0.40	33	− 6.3	0.16	5	6.1	0.68	6	14.5	0.64	15	8.6	0.56	18	− 0.8	0.12
2,000	15	− 3.3	0.28	7	10.3	0.44	19	1.7	0.20	26	− 7.0	0.28	5	4.7	0.56	6	13.2	0.52	15	7.3	0.52	18	− 1.8	0.40
2,250	14	− 4.3	0.40	6	9.1	0.48	16	1.2	0.20	25	− 7.8	0.32	5	3.6	0.44	3	12.2	0.40	13	5.8	0.60	17	− 2.7	0.36
2,500	13	− 5.6	0.52	5	8.2	0.36	16	0.3	0.36	23	− 8.8	0.40	4	2.2	0.56	3	11.2	0.40	12	4.4	0.56	15	− 3.6	0.36
2,750	12	− 6.7	0.44	5	7.2	0.40	14	− 0.8	0.44	19	− 9.6	0.32	3	1.0	0.48	2	10.2	0.40	9	3.2	0.48	15	− 4.6	0.40
3,000	10	− 8.1	0.56	4	5.8	0.56	13	− 1.8	0.40	17	−10.7	0.44	2	− 0.4	0.56	......	......	......	9	2.0	0.48	12	− 5.9	0.52
3,250	9	− 9.5	0.56	4	4.5	0.52	10	− 2.9	0.44	13	−12.1	0.56	2	− 1.8	0.56	......	......	......	8	0.6	0.56	11	− 7.2	0.52
3,500	7	−11.0	0.60	3	3.4	0.44	8	− 3.9	0.40	9	−13.7	0.64	2	− 3.2	0.56	......	......	......	6	− 0.6	0.48	9	− 8.6	0.56
3,750	6	−12.0	0.40	3	2.6	0.32	5	− 5.1	0.48	7	−15.2	0.60	2	− 5.0	0.72	......	......	......	6	− 2.0	0.56	7	−10.0	0.56
4,000	4	−13.5	0.60	2	1.2	0.56	5	− 6.3	0.48	4	−16.4	0.48	......	......	......	......	......	......	6	− 3.4	0.56	5	−11.4	0.56
4,250	3	−14.8	0.52	2	− 0.2	0.56	5	− 7.7	0.56	2	−18.3	0.72	......	......	......	......	......	......	6	− 5.0	0.64	4	−12.8	0.56
4,500	1	−16.2	0.56	2	− 1.8	0.64	4	− 9.3	0.64	2	−20.3	0.80	......	......	......	......	......	......	5	− 6.5	0.60	4	−14.2	0.56
4,750	1	−17.9	0.68	2	− 3.5	0.68	3	−11.0	0.68	1	−22.3	0.80	......	......	......	......	......	......	5	− 7.9	0.56	3	−16.0	0.72
5,000	1	−19.5	0.64	2	− 5.2	0.68	2	−12.6	0.64	1	−24.2	0.72	......	......	......	......	......	......	5	− 9.2	0.52	3	−17.4	0.56
5,250	1	−21.1	0.64	2	− 7.1	0.76	1	−13.8	0.48	......	......	......	......	......	......	......	......	......	5	−10.6	0.56	3	−19.0	0.64
5,500	1	−22.6	0.60	1	− 9.0	0.76	1	−15.1	0.52	......	......	......	......	......	......	......	......	......	5	−12.0	0.56	2	−20.6	0.64
5,750	1	−24.1	0.60	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	2	−13.4	0.56	1	−23.5	1.16
6,000	1	−25.6	0.60	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	2	−14.9	0.60	......	......	......
6,250	1	−27.1	0.60	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	−15.7	0.32	......	......	......
6,500	1	−28.5	0.56	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	−18.6	1.16	......	......	......
6,750	1	−29.9	0.56	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	−20.9	0.92	......	......	......
7,000	1	−31.2	0.52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	−23.7	1.12	......	......	......
7,250	1	−32.5	0.52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
7,500	1	−33.8	0.52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......

Altitude above sea level.	III.												IV.											
	Spring.			Summer.			Autumn.			Winter.			Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.
Meters.		° *C.*	° *C.*		° *C.*	° *C.*		° *C.*	° *C.*		° *C.*	° *C.*		° *C.*	° *C.*		° *C.*	° *C.*		° *C.*	° *C.*		° *C.*	° *C.*
526	22	11.0		21	19.8		28	12.3		21	−3.6		18	6.8		24	19.1		32	10.8		22	−3.4	
750	22	10.3	0.31	21	18.3	0.67	28	11.8	0.22	21	−3.4	−0.09	18	5.2	0.71	24	17.4	0.75	32	9.4	0.62	22	−4.9	0.66
1,000	19	9.6	0.28	20	16.7	0.64	26	11.3	0.20	19	−3.1	−0.12	16	3.6	0.64	24	15.7	0.68	32	8.2	0.48	22	−5.9	0.40
1,250	17	8.8	0.32	19	15.4	0.52	23	10.4	0.36	17	−2.1	−0.40	15	2.3	0.52	22	14.3	0.56	28	7.5	0.28	20	−5.7	−0.08
1,500	16	7.9	0.36	15	14.3	0.44	20	9.5	0.36	15	−1.2	−0.36	14	1.4	0.36	18	13.0	0.52	28	6.8	0.28	17	−5.6	−0.04
1,750	14	7.0	0.36	11	13.0	0.52	14	8.4	0.44	14	−0.9	−0.12	13	0.6	0.32	17	11.7	0.52	24	6.4	0.16	16	−5.7	0.04
2,000	11	5.7	0.52	9	11.6	0.56	14	7.0	0.56	12	−1.5	0.24	13	−0.4	0.40	16	10.4	0.52	22	5.8	0.24	14	−6.3	0.24
2,250	8	4.3	0.56	4	10.0	0.64	10	6.5	0.20	10	−2.7	0.48	13	−1.3	0.36	10	9.0	0.56	18	5.0	0.32	11	−6.9	0.24
2,500	6	3.4	0.36	3	8.7	0.52	6	5.5	0.40	10	−3.9	0.48	10	−2.2	0.36	8	7.7	0.52	16	3.9	0.44	11	−8.0	0.44
2,750	6	2.3	0.44	2	7.4	0.52	3	4.6	0.36	9	−5.4	0.60	10	−3.2	0.40	3	6.3	0.56	13	2.7	0.48	11	−9.3	0.52
3,000	5	0.9	0.56	2	6.3	0.44	2	3.5	0.44	7	−6.9	0.60	9	−4.3	0.44	2	4.4	0.76	10	1.4	0.52	11	−10.7	0.56
3,250	4	−0.5	0.56	2	5.3	0.40	2	2.3	0.48	6	−8.4	0.60	7	−5.7	0.56	2	2.8	0.64	7	0.2	0.48	5	−12.2	0.60
3,500	3	−1.8	0.52	1	4.1	0.48	2	1.1	0.48	5	−9.9	0.60	6	−7.2	0.60	2	1.6	0.48	5	−0.8	0.40	5	−13.6	0.56
3,750	3	−3.4	0.64	1	2.9	0.48	2	−0.3	0.56	4	−11.3	0.56	4	−8.8	0.64	2	0.6	0.40	2	−2.2	0.56	5	−15.1	0.60
4,000	3	−5.2	0.72	1	1.8	0.44	2	−1.7	0.56	4	−12.6	0.52	3	−10.6	0.72				2	−3.6	0.56	4	−16.5	0.56
4,250	3	−6.9	0.68				2	−3.1	0.56	4	−13.6	0.40	3	−12.4	0.72				2	−4.8	0.48	3	−18.4	0.76
4,500	1	−8.0	0.44				2	−4.5	0.56	3	−14.3	0.28	2	−14.0	0.64				2	−5.8	0.40	3	−20.3	0.76
4,750	1	−9.2	0.48				1	−6.2	0.68	2	−15.5	0.48	1	−15.3	0.52				2	−6.6	0.32	1	−22.3	0.80
5,000	1	−10.4	0.48				1	−8.2	0.80	2	−17.6	0.84							1	−8.1	0.60	1	−24.2	0.76
5,250	1	−11.8	0.56				1	−9.8	0.64										1	−9.6	0.60			
5,500	1	−13.2	0.56				1	−10.7	0.36										1	−11.0	0.56			
5,750	1	−14.7	0.60				1	−11.5	0.32										1	−12.4	0.56			
6,000	1	−16.4	0.68				1	−13.7	0.88										1	−13.9	0.60			
6,250	1	−18.3	0.76				1	−16.2	1.00															
6,500	1	−20.0	0.68				1	−19.3	1.24															
6,750	1	−21.8	0.72				1	−22.8	1.40															
7,000																								
7,250																								
7,500																								

TABLE V.—*Mean free air temperatures in front and rear of highs, by seasons, July 1, 1907, to June 30, 1910.*

Altitude above sea level.	Front.												Rear.											
	Spring.			Summer.			Autumn.			Winter.			Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperatures.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.
Meters.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
526	35	5.3	......	34	18.5	......	56	9.7	......	56	−3.4	......	30	11.2	......	30	20.8	......	49	12.9	......	43	−1.6	......
750	35	3.5	0.80	34	17.0	0.67	56	8.3	0.62	56	−4.9	0.67	30	10.7	0.22	30	19.3	0.67	49	12.2	0.31	43	−1.7	0.04
1,000	32	1.7	0.72	34	15.4	0.64	56	7.1	0.48	56	−5.9	0.40	27	9.9	0.32	29	17.5	0.72	46	11.6	0.24	41	−1.7	0.00
1,250	30	0.5	0.48	31	14.0	0.56	51	6.0	0.44	54	−5.8	−0.04	24	8.9	0.40	28	16.2	0.52	42	10.7	0.36	38	−1.2	−0.20
1,500	29	−0.3	0.32	26	12.9	0.44	49	5.2	0.32	50	−5.8	0.00	23	7.8	0.44	23	14.9	0.52	38	9.7	0.40	35	−1.0	−0.08
1,750	28	−1.1	0.32	25	11.7	0.48	44	4.6	0.24	49	−6.1	0.12	19	6.7	0.44	17	13.5	0.56	29	8.5	0.48	32	−1.1	0.04
2,000	28	−1.9	0.32	23	10.5	0.48	41	4.0	0.24	40	−6.7	0.24	16	5.4	0.52	15	12.1	0.56	29	7.1	0.56	30	−1.9	0.32
2,250	27	−2.9	0.40	16	9.2	0.52	34	3.4	0.24	36	−7.4	0.28	13	4.1	0.52	7	10.7	0.56	23	6.0	0.44	27	−2.9	0.40
2,500	23	−4.0	0.44	13	8.1	0.44	32	2.4	0.40	34	−8.5	0.44	10	3.0	0.44	6	9.5	0.48	18	4.7	0.52	25	−4.0	0.44
2,750	22	−5.1	0.44	8	6.9	0.48	27	1.3	0.44	30	−9.5	0.40	9	1.8	0.48	4	8.3	0.48	12	3.6	0.44	24	−5.2	0.48
3,000	19	−6.4	0.52	6	5.3	0.64	23	0.2	0.44	28	−10.7	0.48	7	0.4	0.56	2	7.2	0.44	11	2.4	0.48	19	−6.6	0.56
3,250	16	−7.8	0.56	6	3.9	0.56	17	−0.9	1.14	18	−12.1	0.56	6	−1.0	0.56	2	6.2	0.40	10	1.1	0.52	17	−8.0	0.56
3,500	13	−9.3	0.60	5	2.7	0.48	13	−1.9	0.40	14	−13.6	0.60	5	−2.4	0.56	1	5.0	0.48	8	−0.1	0.48	14	−9.5	0.60
3,750	10	−10.5	0.48	5	1.8	0.36	7	−3.2	0.52	12	−15.1	0.60	5	−4.1	0.68	1	3.8	0.48	8	−1.5	0.56	11	−10.9	0.56
4,000	7	−12.1	0.64	2	0.4	0.56	7	−4.4	0.48	8	−16.4	0.52	3	−5.9	0.72	1	2.7	0.44	8	−2.9	0.56	9	−12.2	0.52
4,250	6	−13.7	0.64	2	−1.0	0.56	7	−5.7	0.52	5	−18.3	0.76	3	−7.6	0.68	......	......	......	8	−4.4	0.60	8	−13.4	0.48
4,500	3	−15.2	0.60	2	−2.6	0.64	6	−7.1	0.56	5	−20.2	0.76	1	−8.7	0.44	......	......	......	7	−5.9	0.60	7	−14.5	0.44
4,750	2	−16.7	0.60	2	−4.3	0.68	5	−8.5	0.56	2	−22.2	0.80	1	−9.9	0.48	......	......	......	6	−7.4	0.60	5	−16.0	0.60
5,000	1	−18.3	0.64	2	−6.0	0.68	3	−10.0	0.60	2	−24.1	0.76	1	−11.1	0.48	......	......	......	6	−8.8	0.56	5	−17.3	0.52
5,250	1	−19.9	0.64	2	−7.9	0.76	2	−11.4	0.56	......	......	......	1	−12.5	0.56	......	......	......	6	−10.2	0.56	3	−18.9	0.64
5,500	1	−21.4	0.60	1	−9.8	0.76	2	−12.8	0.56	......	......	......	1	−13.9	0.56	......	......	......	6	−11.5	0.52	2	−20.5	0.64
5,750	1	−22.9	0.60	......	......	......	1	−14.2	0.56	......	......	......	1	−15.4	0.60	......	......	......	3	−12.7	0.48	1	−23.4	1.16
6,000	1	−24.4	0.60	......	......	......	1	−15.7	0.60	......	......	......	1	−17.1	0.68	......	......	......	3	−14.4	0.68	......	......	......
6,250	1	−25.9	0.60	......	......	......	......	......	......	......	......	......	1	−19.0	0.76	......	......	......	2	−16.0	0.64	......	......	......
6,500	1	−27.3	0.56	......	......	......	......	......	......	......	......	......	1	−20.7	0.68	......	......	......	2	−19.0	1.20	......	......	......
6,750	1	−28.7	0.56	......	......	......	......	......	......	......	......	......	1	−22.5	0.72	......	......	......	2	−21.9	1.16	......	......	......
7,000	1	−30.0	0.52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	−24.7	1.12	......	......	......
7,250	1	−31.3	0.52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
7,500	1	−32.6	0.52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......

TABLE VI.—*Mean free air temperatures in lows, by quadrants and seasons, July 1, 1907, to June 30, 1910.*

Altitude above sea level.	I.												II.											
	Spring.			Summer.			Autumn.			Winter.			Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.
Meters.		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*
526	7	12.2	.....	2	22.8	.....	2	5.7	.....	3	0.9	.....	8	10.0	.....	11	20.4	.....	5	5.5	.....	9	-0.5	.....
750	7	11.1	0.49	2	20.6	0.98	2	4.9	0.36	3	-0.1	0.44	8	7.5	1.11	11	18.6	0.80	5	4.3	0.53	9	-2.3	0.80
1,000	7	10.0	0.44	2	19.9	0.28	2	4.2	0.28	2	-1.4	0.52	8	6.3	0.48	11	17.2	0.56	5	2.8	0.60	8	-4.3	0.80
1,250	6	9.1	0.36	2	18.4	0.60	1	4.2	0.00	2	-0.4	-0.40	7	4.5	0.72	11	15.9	0.52	5	2.6	0.08	8	-6.0	0.68
1,500	5	7.5	0.64	2	17.2	0.48	1	4.2	0.00	1	-0.6	0.08	7	2.9	0.64	10	14.6	0.52	3	0.7	0.76	7	-6.8	0.32
1,750	3	6.5	0.40	2	15.8	0.56	1	3.4	0.32	1	-1.9	0.52	7	1.6	0.52	8	13.0	0.64	3	-1.1	0.72	6	-7.3	0.20
2,000	2	5.7	0.32	1	14.7	0.44	1	3.2	0.08	1	-3.2	0.52	6	0.3	0.52	7	11.9	0.44	2	-2.3	0.48	4	-6.1	-0.48
2,250	1	3.1	1.04				1	4.0	-0.32	1	-4.6	0.56	5	-1.0	0.52	7	10.8	0.44	2	-3.3	0.40	3	-5.7	-0.16
2,500	1	1.4	0.68				1	2.6	0.56	1	-6.0	0.56	4	-2.0	0.40	6	9.2	0.64	2	-4.1	0.32	3	-7.3	0.64
2,750	1	-0.1	0.60							1	-7.6	0.64	3	-3.3	0.52	6	7.6	0.64				2	-8.7	0.56
3,000	1	-2.0	0.76							1	-9.4	0.72	3	-4.4	0.44	6	5.9	0.68				2	-9.9	0.48
3,250	1	-4.2	0.88							1	-9.7	0.12	3	-5.4	0.40	6	4.2	0.68				2	-10.7	0.32
3,500	1	-6.3	0.84										1	-5.5	0.04	6	2.8	0.56				1	-11.8	0.44
3,750	1	-8.4	0.84										1	-6.9	0.56	5	1.4	0.56				1	-12.9	0.44
4,000	1	-10.4	0.80													5	-0.2	0.64				1	-14.1	0.48
4,250																5	-1.7	0.60						
4,500																4	-2.8	0.44						
4,750																3	-4.4	0.64						
5,000																3	-5.9	0.60						
5,250																3	-7.3	0.56						
5,500																2	-9.0	0.68						
5,750																2	-11.0	0.80						
6,000																1	-13.0	0.80						
6,250																1	-15.0	0.80						
6,500																1	-16.4	0.56						
6,750																1	-17.9	0.60						
7,000																1	-19.3	0.56						

TABLE VI.—*Mean free air temperatures in lows, by quadrants and seasons, July 1, 1907, to June 30, 1910*—Continued.

Altitude above sea level.	III.												IV.											
	Spring.			Summer.			Autumn.			Winter.			Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.
Meters.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
526	33	13.3		25	20.7		11	10.8		26	2.3		17	11.4		5	17.8		14	14.8		10	2.4	
750	33	11.4	0.84	25	19.3	0.62	11	8.7	0.93	26	1.0	0.58	17	10.1	0.58	5	17.2	0.27	14	13.8	0.44	10	2.6	−0.09
1,000	33	9.7	0.68	25	17.7	0.64	11	6.6	0.84	26	−0.6	0.64	17	9.0	0.44	5	16.3	0.36	14	12.4	0.56	10	2.7	−0.04
1,250	33	7.9	0.72	24	16.1	0.64	11	5.6	0.40	26	−2.0	0.56	17	7.6	0.56	3	15.0	0.52	13	10.8	0.64	9	2.3	0.16
1,500	32	6.3	0.64	23	14.4	0.68	11	3.8	0.72	25	−3.1	0.44	15	6.0	0.64	3	13.9	0.44	11	9.3	0.60	9	1.4	0.36
1,750	31	4.6	0.68	23	12.6	0.72	11	2.5	0.52	21	−4.4	0.52	15	4.4	0.64	3	12.5	0.56	8	8.0	0.52	9	0.3	0.44
2,000	27	3.0	0.64	21	11.2	0.56	11	1.4	0.40	18	−5.7	0.52	13	3.1	0.52	3	11.0	0.60	7	6.9	0.44	8	−1.1	0.56
2,250	23	1.6	0.52	19	9.8	0.56	9	0.3	0.44	15	−7.1	0.56	10	1.9	0.48	2	9.2	0.32	6	6.1	0.32	8	−2.2	0.44
2,500	21	0.1	0.60	17	8.3	0.60	7	−0.4	0.28	12	−8.4	0.52	8	0.3	0.64	1	7.5	0.68	3	5.8	0.12	2	−4.0	0.72
2,750	17	−1.4	0.60	14	6.9	0.56	5	−2.3	0.76	10	−9.4	0.40	7	−1.4	0.68	1	5.9	0.64	3	4.8	0.40	2	−6.2	0.88
3,000	14	−2.8	0.56	14	5.6	0.52	4	−4.0	0.68	6	−10.9	0.60	7	−3.0	0.64	1	4.2	0.68	3	3.7	0.44	2	−8.4	0.88
3,250	13	−4.2	0.56	10	4.1	0.60	4	−5.0	0.40	5	−12.1	0.48	6	−4.3	0.52	1	2.6	0.64	2	2.2	0.60	1	−11.2	1.12
3,500	9	−5.7	0.60	8	2.5	0.64	2	−7.0	0.80	5	−13.2	0.44	4	−5.1	0.72	1	0.9	0.68	2	0.7	0.60			
3,750	7	−7.1	0.56	7	0.9	0.64	2	−9.0	0.80	2	−15.0	0.72	2	−6.2	0.44	1	−0.7	0.64	1	−0.9	0.64			
4,000	6	−8.6	0.60	7	−0.5	0.56	1	−11.0	0.80	2	−16.7	0.68	1	−6.7	0.20				1	−2.6	0.68			
4,250	3	−10.5	0.76	5	−2.0	0.60				1	−17.7	0.40							1	−4.1	0.60			
4,500	2	−12.5	0.80	2	−3.6	0.64				1	−18.8	0.44							1	−5.7	0.64			
4,750				1	−5.2	0.64													1	−7.3	0.64			
5,000				1	−6.7	0.60													1	−9.0	0.68			
5,250				1	−8.3	0.64													1	−10.9	0.76			
5,500				1	−10.0	0.68													1	−12.3	0.56			
5,750																			1	−13.6	0.52			
6,000																								
6,250																								
6,500																								
6,750																								
7,000																								

TABLE VII.—*Mean free-air temperatures, in front and rear of lows, by seasons, July 1, 1907, to June 30, 1910.*

Altitude above sea level.	Front.												Rear.											
	Spring.			Summer.			Autumn.			Winter.			Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.	Observations.	Temperature.	Δt per 100 m.
Meters.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
526	24	11.7		7	19.2		16	13.6		13	2.0		41	12.7		36	20.6		16	9.1		35	1.6	
750	24	10.5	0.53	7	18.1	0.49	16	12.6	0.44	13	1.9	0.04	41	10.7	0.89	36	19.1	0.67	16	7.3	0.80	35	0.2	0.62
1,000	24	9.4	0.44	7	17.3	0.32	16	11.3	0.52	12	1.8	0.04	41	9.1	0.64	36	17.6	0.60	16	5.4	0.76	34	− 1.5	0.68
1,250	23	8.2	0.48	5	15.9	0.56	14	9.8	0.60	11	1.6	0.08	40	7.3	0.72	35	16.1	0.60	16	4.6	0.32	34	− 3.0	0.60
1,500	20	6.6	0.64	5	14.7	0.48	12	8.5	0.52	10	0.8	0.32	39	5.7	0.64	33	14.5	0.64	14	2.8	0.72	32	− 4.1	0.44
1,750	18	5.1	0.60	5	13.3	0.56	9	7.2	0.52	10	− 0.3	0.44	38	4.1	0.64	31	12.9	0.64	14	1.4	0.56	27	− 5.2	0.44
2,000	15	3.8	0.52	4	11.9	0.56	8	6.2	0.40	9	− 1.7	0.56	33	2.6	0.60	28	11.6	0.52	13	0.2	0.48	22	− 6.0	0.32
2,250	11	2.4	0.56	2	10.3	0.64	7	5.6	0.24	9	− 2.9	0.48	28	1.2	0.56	26	10.3	0.52	11	− 0.9	0.44	18	− 7.1	0.44
2,500	9	0.8	0.64	1	8.6	0.68	4	5.0	0.24	3	− 4.5	0.64	25	− 0.2	0.56	23	8.8	0.60	9	− 1.6	0.28	15	− 8.4	0.52
2,750	8	− 0.9	0.68	1	7.0	0.64	3	4.0	0.40	3	− 6.5	0.80	20	− 1.6	0.56	20	7.3	0.60	5	− 3.5	0.76	12	− 9.4	0.40
3,000	8	− 2.5	0.64	1	5.3	0.68	3	2.9	0.44	3	− 8.5	0.80	17	− 3.0	0.56	20	5.9	0.56	4	− 5.2	0.68	8	−10.8	0.56
3,250	7	− 3.9	0.56	1	3.7	0.64	2	1.4	0.60	2	−10.1	0.64	16	− 4.3	0.52	16	4.3	0.64	4	− 6.2	0.40	7	−11.8	0.40
3,500	5	− 5.1	0.48	1	2.0	0.68	2	− 0.1	0.60				10	− 5.6	0.52	14	2.7	0.64	2	− 8.2	0.80	6	−12.9	0.44
3,750	3	− 6.5	0.56	1	0.4	0.64	1	− 1.7	0.64				8	− 7.0	0.56	12	1.2	0.60	2	−10.2	0.80	3	−14.4	0.60
4,000	2	− 7.7	0.48				1	− 3.4	0.68				6	− 8.5	0.60	12	0.3	0.60	1	−12.2	0.80	3	−15.9	0.60
4,250							1	− 4.9	0.60				3	−10.4	0.76	10	− 1.8	0.60				1	−16.9	0.40
4,500							1	− 6.5	0.64				2	−12.4	0.80	6	− 3.0	0.48				1	−18.0	0.44
4,750							1	− 8.1	0.64							4	− 4.6	0.56						
5,000							1	− 9.8	0.68							4	− 6.1	0.60						
5,250							1	−11.7	0.76							4	− 7.5	0.56						
5,500							1	−13.1	0.56							3	− 9.2	0.68						
5,750							1	−14.4	0.52							2	−11.2	0.80						
6,000																2	−13.2	0.80						
6,250																1	−14.7	0.60						
6,500																1	−16.1	0.56						
6,750																1	−17.6	0.60						
7,000																1	−19.0	0.56						

TABLE VIII.—*Mean free air temperatures between highs and lows, by seasons, July, 1907, to June, 1910.*

Altitude above sea level.	Low, nw., w., or sw.; high, ne., e., or se.											
	Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.
Meters.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
526	56	13.4		56	22.1		33	14.1		32	1.8	
750	56	12.4	0.40	56	20.5	0.64	33	13.6	0.20	32	1.9	−0.04
1,000	52	11.3	0.44	53	18.9	0.64	33	12.8	0.32	31	2.0	−0.04
1,250	48	10.0	0.52	47	17.5	0.56	32	11.6	0.48	31	1.1	0.36
1,500	45	8.4	0.64	45	15.9	0.64	29	10.3	0.52	29	0.3	0.32
1,750	39	6.7	0.68	40	14.4	0.60	26	8.9	0.56	28	− 0.7	0.40
2,000	37	5.1	0.64	31	12.9	0.60	25	7.5	0.56	27	− 1.8	0.44
2,250	33	3.5	0.64	18	11.7	0.48	22	5.9	0.64	22	− 2.7	0.36
2,500	29	2.0	0.60	8	10.5	0.48	19	4.4	0.60	20	− 3.8	0.44
2,750	25	0.5	0.60	7	9.7	0.32	18	3.0	0.56	17	− 4.5	0.28
3,000	20	− 1.0	0.60	4	8.3	0.56	16	1.6	0.56	16	− 5.8	0.52
3,250	17	− 2.6	0.64	4	6.8	0.60	13	0.2	0.56	14	− 7.4	0.64
3,500	14	− 4.4	0.72	2	4.6	0.88	10	− 1.4	0.64	10	− 9.1	0.68
3,750	11	− 6.1	0.68	2	2.2	0.96	8	− 3.1	0.68	5	−10.4	0.52
4,000	10	− 7.7	0.64	1	− 0.4	1.04	6	− 4.5	0.56	5	−11.8	0.56
4,250	7	− 9.4	0.68	1	− 2.9	1.00	5	− 6.0	0.60	4	−13.1	0.52
4,500	7	−11.0	0.64				4	− 8.0	0.80	2	−14.1	0.40
4,750	5	−12.4	0.56				4	−10.3	0.92			
5,000	4	−13.9	0.60				1	−12.6	0.92			
5,250	3	−15.5	0.64									
5,500	2	−17.5	0.80									
5,750	1	−19.4	0.76									
6,000	1	−21.3	0.76									
6,250	1	−23.0	0.68									
6,500	1	−24.7	0.68									
6,750	1	−26.3	0.64									
7,000	1	−27.9	0.64									

Altitude above sea level.	Low, ne., or e.; high, nw., w., or sw.											
	Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.
Meters.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
526	36	10.7		69	21.9		34	11.6		37	− 0.7	
750	36	8.8	0.76	69	20.4	0.60	34	10.2	0.56	37	− 2.4	0.68
1,000	35	7.0	0.72	68	18.9	0.60	33	8.6	0.64	37	− 3.9	0.60
1,250	33	5.3	0.68	68	17.3	0.64	33	6.9	0.68	35	− 5.1	0.48
1,500	33	3.9	0.56	66	15.8	0.60	32	5.2	0.68	33	− 5.8	0.28
1,750	31	2.7	0.48	59	14.3	0.60	29	3.8	0.56	28	− 7.2	0.56
2,000	31	1.3	0.56	49	12.9	0.56	27	2.9	0.36	22	− 7.8	0.24
2,250	29	0.1	0.48	41	11.6	0.52	22	2.1	0.32	20	− 8.2	0.16
2,500	24	− 0.9	0.40	32	10.2	0.56	20	1.2	0.36	18	− 9.1	0.36
2,750	20	− 2.0	0.44	25	8.6	0.64	19	0.0	0.48	13	− 9.6	0.20
3,000	18	− 3.4	0.56	24	6.9	0.68	16	− 1.6	0.64	8	−10.6	0.40
3,250	18	− 5.0	0.64	21	5.2	0.68	13	− 3.0	0.56	6	−12.2	0.64
3,500	14	− 6.6	0.64	18	3.6	0.64	12	− 4.5	0.60	4	−14.2	0.80
3,750	11	− 8.2	0.64	17	2.0	0.64	10	− 5.9	0.64	3	−15.7	0.60
4,000	8	− 9.8	0.64	11	0.4	0.64	7	− 7.3	0.56	1	−16.9	0.48
4,250	6	−11.4	0.64	5	− 1.4	0.72	5	− 9.0	0.68	1	−18.4	0.60
4,500	4	−13.2	0.72	4	− 3.2	0.72	5	−10.6	0.64	1	−20.2	0.72
4,750	3	−14.9	0.68	2	− 4.2	0.40	3	−12.7	0.84	1	−22.2	0.80
5,000	2	−16.7	0.72	1	− 4.9	0.28	2	−15.7	1.20			
5,250	1	−18.2	0.60	1	− 5.6	0.28	1	−19.1	1.36			

TABLE VIII.—*Mean free air temperatures between highs and lows, by seasons, July. 1907, to June, 1910*—Continued.

Altitude above sea level.	Low, moving up Atlantic coast; high, n.											
	Spring.			Summer.			Autumn.			Winter.		
	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.	Observations.	Temperature.	Δt per 100 meters.
Meters.		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*
526	7	6.8	....	13	22.2	....	11	15.5	....	2	−0.6	....
750	7	5.0	0.72	13	20.6	0.64	11	13.8	0.68	2	0.9	−0.60
1,000	6	3.4	0.64	13	19.1	0.60	11	12.5	0.52	2	0.3	0.24
1,250	6	2.8	0.24	11	17.6	0.60	10	11.2	0.52	2	−1.7	0.80
1,500	6	2.5	0.12	11	16.0	0.64	10	9.8	0.56	1	−3.5	0.72
1,750	6	2.0	0.20	9	14.4	0.64	10	8.6	0.48	1	−4.8	0.52
2,000	3	0.6	0.56	9	13.0	0.56	10	7.5	0.44	......	......	......
2,250	3	−0.7	0.52	7	11.8	0.48	8	6.8	0.28	......	......	......
2,500	3	−1.7	0.40	6	10.2	0.64	6	6.0	0.32	......	......	......
2,750	1	−3.1	0.56	5	9.0	0.48	5	5.1	0.36	......	......	......
3,000	......	......	......	5	7.9	0.44	4	3.9	0.48	......	......	......
3,250	......	......	......	4	6.9	0.40	3	2.4	0.60	......	......	......
3,500	......	......	......	3	5.6	0.52	3	0.8	0.64	......	......	......
3,750	......	......	......	2	4.2	0.56	2	− 0.5	0.52	......	......	......
4,000	......	......	......	2	2.9	0.52	1	− 2.3	0.68	......	......	......

TABLE IX.—*Low, nw., w., or sw.; high, ne., e., or se. of Mount Weather.*

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1908.	*m.p.s.*										
July 1	2	ssw.[1]	0.	sw.	......	......	cw.	2 Few.	ci.-st. cu.	wsw. wsw.	
July 3	3	s.	ssw.	sw.	......	......	cw.	8	cu.	sw.	
July 4	3	sw.	wsw.	wsw.	......	......	cw.	3 3 2	ci.-st. a.-cu. st.	wsw. wsw. wsw.	Solar halo.
July 10	4	se.	e.	0.	......	......	ccw.	0	......	......	
	4	se.	e.	sw.	......	......	cw.	0	......	......	
July 17	6	s.	ssw.	sw.	w.	w.	cw.	5	ci.	w.	
July 20	2	s.	s.	wsw.	......	......	cw.	2	cu.	wsw.	
July 21	5	se.	sse.	sw.	......	......	cw.	2 6	a.-cu. st.	sw. sse.	
July 22	3	se.	0.	w.	......	......	cw.	7 Few.	a.-st. cu.	w. 0.	
Aug. 3	2	s.	sse.	nw.	......	......	cw.	2 Few.	ci. cu.	nw. nw.	
Aug. 4	3	sse.	ssw.	w.	......	......	cw.	0	......	......	
Aug. 11	4	sw.	wsw.	w.	......	......	cw.	2	cu.	w.	
Aug. 12	3	ssw.	ssw.	w.	......	......	cw.	1	st.	w.	
Aug. 17	5	s.	ssw.	sw.	......	......	cw.	1 6	ci. cu.	wnw. sw.	Thunderstorm and rain.
Sept. 1	3	se.	sse.	wnw.	......	......	cw.	0	......	......	
Sept. 5	5	se.	sse.	s.	......	......	cw.	Dense.	Fog.	se.	Light rain.
Sept. 23	2	s.	wsw.	0.	......	......	cw.	0	......	......	
Oct. 8	5	se.	s.	ssw.	......	......	cw.	6 2	ci. st.	sw. s.	
Oct. 24	5	se.	se.	se.	......	......	......	Dense.	Fog.	se.	Do.
Oct. 28	8	nw.	nw.	......	......	......	......	10 Dense.	st. Fog.	sw. nw.	Do.
Nov. 9	8	s.	sw.	wsw.	wsw.	......	cw.	5 2	ci. a.-cu.	w. w.	
Nov. 10	9	s.	sw.	wsw.	w.	w.	cw.	Few.	ci.-st.	w.	
Nov. 16	7	sw.	wsw.	w.	w.	......	cw.	Few.	a.-st.	(?)	
Nov. 19	5	ssw.	wsw.	w.	wnw.	wnw.	cw.	2	ci.	wnw.	
Nov. 25	6	se.	s.	sw.	wsw.	......	cw.	Dense.	Fog.	se.	
Nov. 26	5	s.	sw.	sw.	sw.	......	cw.	Dense.	Fog.	s.	
Nov. 30	6	sw.	sw.	sw.	wsw.	......	cw.	5 5	ci. a.-st.	w. w.	
Dec. 4	7	s.	sw.	sw.	sw.	wsw.	cw.	5 5	ci.-st. a.-st.	w. w.	Solar halo.

[1] Variable.

Table IX.—*Low, nw., w., or sw.; high, ne., e., or se. of Mount Weather*—Continued.

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1908.	*m.p.s.*										
Dec. 11	6	sw.	wsw.	wsw.	wsw.	......	cw.	10	st.	wsw.	Heavy snow.
Dec. 17	7	se.	s.	wsw.	......	......	cw.	Dense.	Fog.	se.	Light rain.
Dec. 19	3	s.[1]	w.	w.	w.	......	cw.	2 5	ci. st.-cu.	w. w.	
1909											
Feb. 4	6	ssw.	wsw.	w.	wnw.	......	cw.	4	ci.-st.	nw.	
Feb. 5	4	sw.	wsw.	wsw.	wsw.	wsw.	cw.	5	a.-st.	wsw.	
Feb. 9	6	se.	s.	ssw.	sw.	......	cw.	8 10	a.-st. st.	sw. sw.	Light snow.
Feb. 13	5	sw.	wsw.	wnw.	......	......	cw.	10	st.	w.	Light rain.
Feb. 22	4	se.	se.	......	......	......	......	10	st.	sw.	
Feb. 23	11	sse.	s.	......	......	......	cw.	Dense.	Fog.	sse.	Do.
Mar. 6	9	ese.	s.	sw.	sw.	......	cw.	10	st.	wsw.	Light snow.
Mar. 9	7	se.	sw.	sw.	......	......	cw.	Dense.	Fog.	se.	
Mar. 13	3	w.	w.	......	......	......	......	10 Dense.	st. Fog.	w. w.	Light rain.
Mar. 16	8	s.	ssw.	sw.	wsw.	w.	cw.	5	ci.-st.	w.	
Mar. 19	7	s.	wsw.	w.	......	......	cw.	10	st.	wsw.	Do.
Mar. 24	6	s.	sw.	wsw.	w.	w.[2]	cw.	3 5 10	ci. a.-cu. st.-cu.	wnw. wnw. wsw.	Do.
Apr. 2	9	nw.	nw.	......	......	......	......	10 Light.	st. Fog.	nw. nw.	Do.
Apr. 6	8	s.	ssw.	sw.	sw.	wsw.	cw.	6	ci.-st.	w.	Thunderstorm.
Apr. 13	11	se.	sse.	......	......	......	cw.	Dense.	Fog.	se.	Light rain.
Apr. 21	10	ese.	se.	......	......	......	cw.	Dense.	Fog.	ese.	Do.
Apr. 27	9	se.	s.	sw.	sw.	......	cw.	6 Few.	st.-cu. st.	sw. se.	
May 3	8	sse.	ssw.	sw.	sw.	......	cw.	2 2	ci.-st. st.-cu.	sw. sw.	
May 4	4	s.	ssw.	sw.	wsw.	......	cw.	Few. 5	ci.-st. st.-cu.	wsw. w.	Do.
May 5	5	w.	w.	wsw.	......	......	ccw.	5	a.-cu.	w.	
May 6	4	sse.	s.	ssw.	sw.	......	cw.	6 4	ci.-st. cu.	w. w.	
May 8	4	se.	sse.	ssw.	sw.	......	cw.	3 2	cu. st.	s. se.	
May 15	5	wsw.	w.	wnw.	w.	......	cw.	5 5	ci.-st. a.-st.	w. w.	Solar halo.
May 19	4	se.	s.	ssw.	......	......	cw.	9	st.	s.	
May 25	3	sse.	s.	s.	......	......	cw.	8 2	a.-st. cu.	w. nw.	
June 1	5	ese.	sse.	......	......	......	cw.	5 5	ci.-st. a.-st.	nw. nw.	Solar halo; thunderstorm and rain.
June 3	3	se.	ssw.	sw.	......	......	cw.	10	st.	se.	Light rain.
June 7	2	ese.	0.	nw.	......	......	cw.	10	st.	se.	Thunderstorm and rain.
June 9	5	se.	s.	......	......	......	cw.	Dense.	Fog.	se.	Light rain.
June 12	2	s.[1]	ssw.	wsw.	......	......	cw.	3 3	ci.-st. cu.	w. wsw.	
June 22	3	w.	sw.	......	......	......	ccw.	4 6	ci.-cu. st.-cu.	w. wsw.	
June 28	4	n.	wsw.	w.	......	......	cw.	2 8	ci. cu.-n.	w. w.	Do.
June 30	2	se.	0.	nw.	......	......	cw.	0	......	......	

[1] Variable.

[2] wnw. at 5,000 meters.

TABLE X.—*Low, ne. or e.; high, nw., w., or sw. of Mount Weather.*

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1908.	*m.p.s.*										
July 7	6 6	nw.[1] sw.[1]	wsw. wsw.				ccw. cw.	6 1 1	ci.-cu. cu. cu.	w. wsw. sw.	
July 11	2	nw.[1]	nnw.	nnw.			cw.	0			
July 13	4	nw.	nnw.	n.			cw.	2	ci.	nw.	
July 15	3	nw.	nnw.	nw.	wnw.		ccw.	1	ci.-st.	nw.	
Aug. 10	2	sw.[1]	ssw.	sw.				8	cu.	sw.	Light rain.
Aug. 13	6	wsw.	wsw.	wsw.	sww.	wsw.		5 Few.	ci. cu.	w. w.	
Aug. 18	5	nw.	wnw.	wnw.	wnw.		ccw.	4 Few.	ci. st.	nw. nw.	
Aug. 20	7	nw.	nnw.	wnw.	wnw.	w.[2]	ccw.	5 5	a.-cu. cu.	w. wnw.	
Aug. 22	1	nw.[1]	wsw.	wsw.			cow.	9	st.-cu.	wsw.	
Aug. 24	2	n.	0	nw.			ccw.	10	st.	se.	
Sept. 2	9	nw.	wnw.	wnw.	w.		ccw.	10	st.-cu.	w.	
Sept. 7	5	nw.	nnw.	nw.	wnw.	w.	ccw.	3 3	ci. st.-cu.	w. wnw.	
Sept. 17	7	nw.	n.	nne.			cw.	10	ci.-st.	w.	Solar halo.
Sept. 18	6	nw.	nnw.	nnw.			cw.	0			
Sept. 19	9	nw.	nnw.	n.			cw.	0			
Oct. 1	6	nw.	wnw.	w.			ccw.	10 Light.	st. Fog.	sw. nw.	Light rain.
Oct. 27	3	nw.	nw.	wsw.	sw.		ccw.	2 1	ci. a.-cu.	sw. sw.	
Oct. 30	13	nw.	nw.	nw.	nw.			6	st.-cu.	nw.	
Nov. 5	17	nw.	nw.					2	st.-cu.	nw.	Stationary clouds; ligh snow.
Nov. 12	13	nw.	nw.	wnw.	w.		ccw.	Few.	st.-cu.	wnw.	
Nov. 17	14	nw.	w.	w.			ccw.	0			
Nov. 20	9	nw.	nw.	nw.	nw.	nw.		4 2	a.-cu. st.-cu.	sw. nw.	
Dec. 1	8	wnw.	wnw.	w.	w.		ccw.	8	ci.-st.	w.	
Dec. 5	6	nw.	nw.					8	st.	nw.	Light snow.
Dec. 9	5	wsw.	w.	wnw.	wnw.		cw.	10	st.	wnw.	Do.
Dec. 21	6	w.	w.	w.				4 4	ci.-st. a.-st.	w. wsw.	Solar halo.
Dec. 31	16	wnw.	wnw.	nw.			cw.	0			
1909.											
Jan. 11	6	w.	w.	wnw.	w.			9	st.-cu.	w.	
Jan. 12	20	nw.	wnw.	wsw.			ccw.	10	st.	wsw.	
Jan. 25	8	wnw.	wnw.	wnw.				6 Few.	ci. st.-cu.	w. w.	
Jan. 26	13	wnw.	nw.	nw.	nw.		cw.	Few.	st.-cu.	nw.	
Feb. 11	8	w.	w.	wnw.			cw.	Few.	st.-cu.	nw.	
Mar. 5	11	wnw.	wnw.	wnw.	wnw.			1	st.-cu.	nw.	
Mar. 17	13	nw.	nw.	wnw.	nw.			Few.	st.-cu.	nw.	
Mar. 31	17	nw.	nw.	nw.				5	st.-cu.	nw.	
Apr. 8	6	ssw.	ssw.	sw.			cw.	10	st.	w.	
Apr. 9	15	wnw.	w.	w.	w.		ccw.	5	st.-cu.	wnw.	
Apr. 14	9	nw.	nnw.				cw.	Dense.	Fog.	nw.	Light rain.
Apr. 15	10	nw.	nw.	wnw.			ccw.	5	st.-cu.	nw.	
Apr. 23	8	nw.	wnw.	w.	w.		ccw.	10 Light.	st. Fog.	nw. nw.	Do.
Apr. 26	10	nw.	nw.	nw.	nw.			2 1	a.-st. st.-cu.	w. nw.	
May 7	5	wnw.	w.	wsw.			ccw.	5	ci.-st.	wsw.	
May 11	10	nw.	nw.	nw.	nnw.	n.	cw.	0			
May 14	6	w.	w.	w.	w.	w.		5 3 2	ci.-st. a.-cu. st.-cu.	w. w. w.	
May 18	7	nnw.	nw.	wnw.	wnw.	wnw.	ccw.	1	ci.-st.	nw.	
May 31	5	nw.	nw.	nw.	wnw.		ccw.	10	a.-st.	w.	Do.
June 2	5	w.	w.	w.	w.			6 Few.	ci. st.	w. w.	
June 10	4	w.[1]	wnw.	wnw.	wnw.		cw.	5 5	ci.-cu. st.	wnw. wnw.	Thunderstorm and rain.
June 11	5	nnw.	nnw.	nw.			ccw.	2 8 Light.	st.-cu. st. Fog.	nw. nnw. nnw.	Light rain.
June 14	6	w.	w.	w.	w.	wsw.	ccw.	5 3 Few.	ci.-st. a.-st. cu.	sw. sw. w.	

[1] Variable.

[2] w. at 5,000 meters.

X.—*Low, ne. or e.; high, nw., w., or sw. of Mount Weather*—Continued.

Date.	Surface wind velocity.	Wind direction at— Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.	Turning cw. or ccw.	Clouds. Amt.	Kind.	Dir.	Remarks.
1909.	*m.p.s.*										
June 18	12	nw.	nw.	nw.	nw.	......	......	Few.	cu.	nw.	
June 23	6	w.	nw.	nw.	wnw.	......	ccw.	Few. 2	ci. cu.	(?) nw.	
June 24	6	nw.	nw.	nw.	wnw.	wnw.[3]	ccw.	8 2	st.-cu. cu.	w. w.	Thunderstorm and rain.
June 25	5	w.	wnw.	......	......	......	......	1	ci.-cu.	w.	
June 26	4	wnw.	nw.	......	......	......	cw.	1	ci.	w.	

[3] w. at 5,000 and 6,000 meters.

TABLE XI.—*Low moving up Atlantic coast; high n.*

Date.	Surface wind velocity.	Wind direction at— Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.	Turning cw. or ccw.	Clouds. Amt.	Kind.	Dir.	Remarks.
1908.	*m.p.s.*										
July 27	2	se.[1]	0	ne.	n.	......	ccw.	10	st.	n.	Light rain.
July 28	3	se.	e.	ene.	......	......	ccw.	6	cu.	e.	
	3	s.	se.	e.	......	......	ccw.	0	......	......	
July 30	4	e.	ene.	e.	e.	......	......	5 5	ci. st.-cu.	sw. e.	
Sept. 12	2	se.[1]	ssw.	ne.	......	......	ccw.	0	......	......	
Sept. 14	4	e.	ene.	ne.	ne.	......	ccw.	0	......	......	
Oct. 9	4	nnw.	nne.	ne.	ne.	......	ccw.	10 Dense.	a.-st. Fog.	nw. nnw.	
Oct. 10	7	e.	ese.	ese.	se.	sse.	cw.	10 Dense.	st. Fog.	se. e.	Do.
Oct. 23	8	e.	ene.	ese.	ese.	......	cw.	10	st.	e.	Do.
1909.											
May 20	8	ese.	ese.	ese.	......	......	......	10 Light.	st. Fog.	se. ese.	Do.
May 21	10	ene.	ene.	ene.	......	......	......	10 Dense.	st. Fog.	ene. ene.	
May 22	5	n.	ne.	ne.	......	......	cw.	Dense.	Fog.	n.	Do.
May 24	4	ne.	ne.	......	......	......	......	0	......	......	
June 29	4	e.	ene.	......	......	......	ccw.	3 Few.	ci.-st. cu.	sw. nw.	

[1] Variable.

TABLE XII.- *Low nw., w., or sw.; high, ne., e., or se.*

Date.	Surface wind velocity.	Wind direction at Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.	Turning cw. or ccw.	Clouds. Amt.	Kind.	Dir	Remarks.
1909.	*m.p.s.*										
July 10	4	sse.	sse.	s.	......	......	cw.	2 1	ci. cu.	nnw. sse.	
July 12	4	sse.	sw.	w.	wnw.	......	cw.	2 8	a.-cu. st.-cu.	w. w.	Light rain.
July 14	3	se.[1]	e.	wsw.	wsw.	......	cw.	5 Few.	a.-cu. cu.	w. se.	
July 22	4	se.	sw.	w.	......	......	cw.	10	st.-cu.	nnw.	
	7	se.	sse.	ssw.	......	......	cw.	5 3 Few.	a.-cu. st.-cu. st.	nw. nw. se.	
July 27	3	se.[1]	s.	s.	......	......	cw.	5 5	a.-cu. st.-cu.	w. sse.	

[1] Variable.

TABLE XII.—*Low nw., w., or sw.; high, ne., e., or se.*—Continued.

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1909.	*m.p.s.*										
Aug. 1	1	e.[1]	ese.	......	......	......	cw.	10 Dense.	st. Fog.	e. e.	
Aug. 12	5	se.	sse.	wsw.	wsw.	......	cw.	10	st.	ssw.	Light rain.
Aug. 13	3	ese.	wnw.	nw.	......	......	cw.	8	st.-cu.	ese.	
Aug. 14	5	se.	sw.	sw.	......	......	cw.	10	st.	se.	
Aug. 15	6	se.	s.	......	......	......	cw.	Dense.	Fog.	se.	Do.
Aug. 28	3	e.	w.	wnw.	......	......	cw.	3	ci.	w.	
Sept. 4	5	sse.	sw.	w.	w.	......	cw.	5 4 Light.	a.-cu. st. Fog.	w. sse. sse.	
Sept. 9	4	se.	s.	s.	sw.	......	cw.	5 5	cu. st.-cu.	sse. se.	
Sept. 22	5	sse.	s.	wsw.	......	......	cw.	3 2 2	ci.-st. a.-cu. st.	sw. sw. sse.	
Sept. 23	4	s.[1]	s.	ssw.	wsw.	......	cw.	5 5	a.-st. cu.-n.	ssw. sw.	Light rain and thunderstorm.
Sept. 29	5	s.	ssw.	sw.	wsw.	wsw.	cw.	0	......	......	
Oct. 14	5	s.	sw.	sw.	wsw.	wsw.[2]	cw.	8 10	ci. st.-cu.	wsw. sw.	Light rain; solar halo.
Nov. 2	5	ssw.	wsw.	wsw.	wsw.	wsw.[2]	cw.	5	st.-cu.	sw.	
Nov. 20	5	ssw.	wsw.	w.	wsw.	wsw.[2]	cw.	2	ci.-st.	w.	
Nov. 22	5	sse.	s.	ssw.	sw.	sw.[3]	cw.	8	ci.-st.	w.	
Dec. 3	3	se.	wsw.	wnw.	wnw.	wnw.	cw.	1	ci.-st.	w.	
Dec. 17	5	ssw.	wsw.	w.	w.	w.	cw.	6	st.-cu.	wnw.	
1910.											
Jan. 23	6	se.	ssw.	sw.	......	......	cw.	9	a.-st.	sw.	
Jan. 26	7	se.	ssw.	sw.	wsw.	w.	cw.	10 Few.	a.-st. st.	wsw. se.	Rain and sleet.
Jan. 30	7	s.	ssw.	sw.	wsw.	......	cw.	9 Few.	a.-st. st.	w. s.	Light snow; solar halo.
Feb. 9	8	sse.	s.	ssw.	ssw.	......	cw.	10 Dense.	st.-cu. Fog.	w. sse.	Light rain.
Feb. 15	6	ssw.	sw.	wsw.	w.	......	cw.	9	st.-cu.	wsw.	
Feb. 16	6	sw.	sw.	sw.	wsw.	wsw.	cw.	4 5	ci.-cu. a.-cu.	wsw. wsw.	
Feb. 17	8	se.	s.	......	......	......	cw.	Dense.	Fog.	se.	Do.
Feb. 21	5	ssw.	w.	w.	wsw.	......	cw.	10	st.-cu.	sw.	Do.
Mar. 6	8	se.	s.	sw.	w.	......	cw.	3 3	ci.-st. a.-st.	w. w.	
Mar. 23	5	ese.	sse.	ssw.	......	......	cw.	Few.	cu.	w.	
Apr. 5	5	wsw.	w.	w.	wsw.	wsw.	cw.	3	ci.	w.	
Apr. 11	8	sse.	ssw.	sw.	wsw.	w.[4]	cw.	4 Few.	ci. cu.	wnw. w.	Solar halo.
Apr. 15	6	ssw.	sw.	wsw.	wsw.	......	cw.	3 3 4	ci.-st. a.-st. st.-cu.	w. w. wsw.	Light rain; solar halo.
Apr. 16	11	e.	ese.	s.	sw.	wsw.	cw.	4 2 2	ci.-st. st.-cu. cu.	w. ssw. se.	Solar halo.
Apr. 17	11	ese.	e.	......	......	......	ccw.	Dense.	Fog.	ese.	Light rain.
Apr. 27	6 4	se. s.	s. ssw.	....	....	....	cw. cw.	2 9	cu. st.-cu.	ssw. ssw.	
Apr. 29	9	sse.	ssw.	w.	wnw.	wnw.	cw.	2 3 3	ci.-st. a.-cu. a.-st.	wnw. wnw. wnw.	Solar halo.
May 1	8	se.	sw.	wsw.	......	......	cw.	7	ci.-st.	w.	
May 2	9	se.	s.	ssw.	sw.	......	cw.	Few.	a.-cu.	(?)	
May 7	7	s.	s.	ssw.	ssw.	......	cw.	8 10	ci.-st. st.-cu.	w. ssw.	Do.
May 8	6	sse.	s.	wsw.	......	......	cw.	5 3 2	a.-st. st.-cu. cu.	sw. sse. s.	
May 10	3	ssw.	w.	......	......	......	cw.	10	st.-cu.	w.	
May 20	6	s.	s.	ssw.	sw.	sw.[3]	cw.	9 10 Dense.	ci.-st. st. Fog.	w. s. s.	Light rain; solar halo.
May 21	3	s.	w.	wnw.	......	......	cw.	8	cu.	wnw.	
May 22	5	ese.	se.	wsw.	......	......	cw.	6 3	ci. st.	sw. ese.	
May 29	5	s.[1]	s.	wnw.	......	......	cw.	Few.	ci.	(?)	
June 9	9	se.	s.	ssw.	......	......	cw.	10 Dense.	st. Fog.	se. se.	Light rain.
June 10	6	e.	e.	......	......	......	......	10 Dense.	st. Fog.	e. e.	Do.

[1] Variable.

[2] wsw. at 5,000 meters.

[3] sw. at 5,000 meters.

[4] w. at 5,000 to 7,000 meters.

TABLE XIII.—*Low, ne. or e.; high, nw., w., or sw.*

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1909.	*m.p.s.*										
July 15	4	w.	wsw.	sw.	......	......	ccw.	9	st.-cu.	w.	Light rain.
July 17	6	wnw.	wnw.	wnw.	wnw.	......	......	5	cu.	wnw.	
July 18	6	w.	w.	wnw.	wnw.	w.	......	3	ci.	wnw.	
								4	a.cu.	w.	
								2	cu.	w.	
July 19	10	nw.	nw.	nw.	......	......	......	Few.	cu.	nw.	
July 29	4	wnw.	wnw.	w.	......	......	ccw.	8	cu.	wnw.	Thunderstorm.
								2	cu.-n.	wnw.	
July 30	7	wnw.	wnw.	wnw.	......	......	......	2	ci.-st.	w.	
								4	a.-cu.	w.	
								2	cu.	w.	
Aug. 5	2	e.	......	sw.	......	......	cw.	8	cu.	wnw.	Rain and thunderstorm.
								8	st.	wnw.	
	2	wnw.[1]	nw.	nw.	......	......	cw.	9	a.-st.	nw.	
Aug. 10	6	nnw.	nw.	nw.	nw.	nw.[2]	ccw.	3	ci.-st.	nw.	
								2	cu.	nw.	
								7	st.	nnw.	
Aug. 26	5	w.	wnw.	wnw.	w.	......	......	3	ci.-st.	w.	Light rain; solar halo.
								3	a.-cu.	w.	
								3	st.-cu.	wnw.	
								3	st.	w.	
Aug. 29	8	wnw.	w.	w.	w.	w.	ccw.	4	ci.	w.	
								3	a.-cu.	w.	
								3	st.-cu.	w.	
Sept. 17	3	nnw.	nw.	w.	......	......	ccw.	2	cu.	w.	
Sept. 28	7	nw.	nw.	nw.	wnw.	w.[3]	ccw.	Few.	cu.	nw.	
Oct. 1	8	wnw.	wnw.	wnw.	sw.	......	ccw.	4	st.-cu.	w.	
Oct. 2	10	wnw.	wnw.	wnw.	wnw.	......	......	5	st.-cu.	nw.	
Oct. 13	9	wnw.	w.	w.	w.	wsw.	ccw.	Few.	ci.	(?)	
								Few.	cu.	(?)	
Oct. 16	15	nw.	nw.	nw.	nw.	......	......	7	st.-cu.	w.	
Oct. 22	13	w.	w.	w.	......	......	......	Few.	cu.	w.	
Oct. 26	6	wsw.	w.	w.	wsw.	wsw.[3]	......	5	ci.-st.	wsw.	Solar halo.
Oct. 27	5	wsw.	w.	w.	w.	w.[3]	cw.	6	ci.-cu.	w.	
								4	st.-cu.	w.	
								Few.	st.	w.	
Oct. 28	10	wnw.	nw.	wnw.	wnw.	......	cw.	9	st.-cu.	wnw.	Light snow.
Nov. 3	8	wnw.	wnw.	wnw.	nw.	nw.	cw.	Few.	a.-cu.	(?)	
								2	cu.	wnw.	
Nov. 21	5	wsw.	wsw.	wnw.	w.	......	cw.	5	a.-cu.	w.	
Dec. 4	12	nw.	nw.	nw.	nw.	nw.[2]	......	1	a.-cu.	nw.	
								5	st.	nw.	
Dec. 8	10	wnw.	wnw.	wnw.	wnw.	......	......	4	ci.	w.	Solar halo.
								2	a.-cu.	sw.	
								1	st.	w.	
Dec. 9	11	wnw.	nw.	wnw.	w.	w.	ccw.	3	st.-cu.	wnw.	
Dec. 18	16	wnw.	nw.	nw.	......	......	cw.	Few.	cu.	nw.	
Dec. 19	5	nw.	wnw.	w.	w.	......	ccw.	3	ci.-st.	w.	
								4	a.-st.	w.	
Dec. 22	15	nw.	nw.	wnw.	wnw.	......	ccw.	5	st.-cu.	wnw.	Light snow.
								5	st.	nw.	
1910.											
Jan. 2	5	wsw.	w.	wnw.	wnw.	......	cw.	10	st.-cu.	wnw.	
Jan. 3	9	wsw.	wsw.	w.	w.	......	cw.	2	ci.	w.	
								6	st.-cu.	w.	
Jan. 6	6	nw.	sw.	sw.	......	......	ccw.	Dense.	Fog.	nw.	Light rain.
Jan. 14	9	nw.	nw.	......	......	......	......	Dense.	Fog.	nw.	
Jan. 19	11	wnw.	wnw.	nw.	......	......	cw.	7	a.-cu.	wsw.	
								Few.	st.-cu.	nw.	
Jan. 31	8	nw.	nw.	......	......	......	......	10	st.	wsw.	Light snow.
Feb. 4	15	wnw.	wnw.	nw.	......	......	cw.	Few.	ci.-cu.	nw.	
Feb. 6	16	wnw.	nw.	nw.	......	......	cw.	6	st.-cu.	nw.	Do.
Mar. 2	7	nw.	w.	w.	......	......	ccw.	Dense.	Fog.	nw.	Light rain.
Mar. 3	8	wnw.	wnw.	w.	w.	w.[3]	ccw.	4	st.-cu.	wnw.	
Mar. 9	8	nw.	wnw.	w.	w.	......	ccw.	6	ci.-st.	w.	Solar halo.
								Few.	cu.	w.	
Mar. 16	12	wnw.	wnw.	wnw.	wnw.	wnw.	......	6	ci.	w.	
								2	st.-cu.	nw.	
Mar. 25	8	wnw.	wnw.	w.	w.	w.[3]	ccw.	3	a.-cu.	w.	
Apr. 8	16	wnw.	wnw.	nw.	nw.	nw.	cw.	3	ci.-st.	nw.	
Apr. 9	11	w.	w.	w.	wnw.	wnw.	cw.	5	ci.-st.	nw.	Light rain.
								5	st.-cu.	wnw.	
Apr. 10	11	wnw.	nw.	nw.	nw.	......	cw.	Few.	ci.-st.	nw.	

[1] Variable.

[2] NW. at 5,000 meters.

[3] W. at 5,000 meters.

TABLE XIII—*Low, ne. or e.; high, nw., w., or sw.*—Continued.

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1910.	*m.p.s.*										
Apr. 22	10	wnw.	nw.	......	......	......	cw.	Few.	st.-cu.	nw.	
May 18	11	w.	w.	w.	w.	wnw.	cw.	6	st.-cu.	wnw.	
May 19	9	wnw.	nw.	nw.	nw.	wnw.	......	Few.	cu.	nw.	
May 26	8	nw.	wnw.	w.	......	......	ccw.	4	cu.	w.	
June 7	12	nw.	nw	wnw.	wnw.	wnw.	ccw.	3	st.-cu.	wnw.	
June 12	6	nw.	nw.	......	......	......	......	10	st.	nw.	Light rain.
June 15	3	se.	0.	se.	......	......	......	10	st.-cu.	se.	
June 18	10	wnw.	nw.	nw.	nw.	nw.	cw.	5 5	a.-st. st.-cu.	nw. nw.	Do.
June 21	4	ese.	s.	se.	......	......	cw.	7	a.-st.	n.	
June 22	3	ese.	0.	0.	......	......	......	7 Few.	ci. cu.	w. se.	
June 23	2	w.	nw.	nw.	......	......	cw.	Few.	cu.	(?)	
June 24	6	nnw.	nw.	nw.	nw.	......	ccw.	4	st.-cu.	nw.	
June 27	4	wnw.	sw.	wsw.	......	......	ccw.	6 2	a.-cu. cu.-n.	wnw. wnw.	Thunderstorm.
June 29	7	nw.	nw.	nw.	......	......	......	3	a.-st.	nw.	

TABLE XIV.—*Low, moving up Atlantic coast; high, n.*

Date.	Surface wind velocity.	Wind direction at—					Turning cw. or ccw.	Clouds.			Remarks.
		Surface 526 m.	1,000 m.	2,000 m.	3,000 m.	4,000 m.		Amt.	Kind.	Dir.	
1909.	*m.p.s.*										
July 6	3	ene.	nne.	nw.	......	......	ccw.	10 Dense.	st. Fog.	ene. ene.	
July 7	5	n.	n.	n.	nnw.	nnw.	ccw.	2	cu.	n.	
July 8	3	nnw.	n.	nne.	......	......	cw.	Few.	ci.	nw.	
July 9	7	e.	e.	......	......	......	......	4	ci.	w.	
Aug. 6	3	e.	n.	nnw.	nw.	nw.	ccw.	9	cu.	nw	
Aug. 9	8	wnw.	nw.	nnw.	......	......	cw.	0	......	......	
Aug. 27	5	nnw.	nnw.	nnw.	nnw.	nw.	ccw.	2	ci.	w.	
Sept. 7	3	n.	n.	n.	......	......	......	Few.	cu.	(?)	
Sept. 11	4	e.[1]	ne.	n.	......	......	ccw.	4	cu.	n.	
Sept. 16	3	nne.[1]	n.	wnw.	......	......	ccw.	Dense.	Fog.	nne.	
Sept. 24	5	nw.	n.	nnw.	wnw.	w.	ccw.	Few. 4	ci. st.-cu.	w. w.	
Sept. 27	9	nw.	nnw.	nnw.	nnw.	......	cw.	6 Few. 4	ci.-st. a.-st. st.	sw. sw. nw.	Solar halo.
Nov. 24	10	nw.	n.	......	......	......	cw.	Dense.	Fog.	nw.	Light snow.
Dec. 2	7	wnw.	nnw.	......	......	......	cw.	Few.	ci.-st.	nw.	
1910.											
Jan. 24	4	nnw.	nnw.	nnw.	......	......	......	Dense.	Fog.	nnw.	Do.
Mar. 12	8	nnw.	n.	nne.	......	......	cw.	6 2	a.-cu. st.	s. n.	
Mar. 15	14	nw.	nw.	nw.	nnw.	......	cw.	4	st.-cu.	nw.	
May 13	6	nnw.	nnw.	nnw.	nnw.	......	......	3 Few.	ci.-st. cu.	sw. nnw.	
June 30	7	nw.	nnw.	n.	......	......	cw.	2	ci.-st.	nw.	

---

[1] Variable.

TABLE XV.—*Distribution of mean wind directions about centers of high pressure.*

Octant.	Distance from center.	526 m.		1,000 m.		2,000 m.		3,000 m.		4,000 m.		5,000 m.		6,000 m.		7,000 m.	
		Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.
	Kilometers.																
I	0- 500	22	48	22	40	18	30	15	29	9	41	2	79	1	68	1	68
	500-1,000	16	48	16	44	14	32	9	38	2	79	2	79	1	68	1	68
	1,000-2,000	20	30	20	29	19	33	10	41	5	45	2	34	....	....	....	....
II	0- 500	11	35	11	18	9	8	8	5	4	0	1	0	1	0	....	....
	500-1,000	13	60	13	24	12	9	10	17	4	28	1	22	1	22	....	....
	1,000-2,000	5	44	5	27	5	22	3	29	2	22	....	....	....	....	....	....
III	0- 500	16	50	16	11	13	0	10	−12	4	− 11	4	− 11	2	−11	....	....
	500-1,000	6	33	6	− 7	5	10	2	46	2	46	2	34	1	23	....	....
	1,000-2,000	4	59	4	38	4	38	2	23	1	− 22	....	....	....	....	....	....
IV	0- 500	22	62	22	1	17	−29	8	−52	2	− 79	1	− 68	....	....	....	....
	500-1,000	19	18	18	−14	15	−42	10	−39	7	− 42	1	− 46	1	−46	....	....
	1,000-2,000	1	−23	1	−68	1	−68	....	....	....	....	....	....	....	....	....	....
V	0- 500	16	37	16	−23	10	−53	3	−68	2	− 67	1	− 90	....	....	....	....
	500-1,000	24	10	24	−25	19	−62	9	−83	6	− 82	3	− 61	3	−61	3	−61
	1,000-2,000	10	15	10	−23	7	−54	5	−63	1	− 90	....	....	....	....	....	....
VI	0- 500	8	15	8	0	5	−29	1	−90	....	....	....	....	....	....	....	....
	500-1,000	26	18	26	− 9	17	−35	3	−95	1	−113	1	−113	....	....	....	....
	1,000-2,000	10	−22	10	−48	4	−56	2	−90	....	....	....	....	....	....	....	....
VII	0- 500	16	52	16	37	11	53	4	86	2	113	1	136	....	....	....	....
	500-1,000	25	54	25	13	17	65	7	99	3	120	2	124	1	136	....	....
	1,000-2,000	5	83	5	66	4	113	....	....	....	....	....	....	....	....	....	....
VIII	0- 500	13	42	13	41	10	37	7	54	2	90	....	....	....	....	....	....
	500-1,000	29	63	29	53	24	58	18	74	4	73	....	....	....	....	....	....
	1,000-2,000	17	79	16	86	14	99	8	106	4	95	....	....	....	....	....	....

TABLE XVI.—*Distribution of mean wind directions about centers of low pressure.*

Octant.	Distance from center.	526 m.		1,000 m.		2,000 m.		3,000 m.		4,000 m.		5,000 m.		6,000 m.		7,000 m.	
		Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.	Observations.	Angle.
	Kilometers.																
I	0- 500	2	22	2	−22	2	− 34	....	....	....	....	....	....	....	....	....	....
	500-1,000	6	45	6	22	3	− 8	2	11	1	0	....	....	....	....	....	....
	1,000-2,000	1	112	1	45	....	....	....	....	....	....	....	....	....	....	....	....
II	0- 500	3	58	3	64	....	....	....	....	....	....	....	....	....	....	....	....
	500-1,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	1,000-2,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
III	0- 500	5	67	5	16	4	56	1	22	1	22	1	22	1	22	....	....
	500-1,000	2	22	2	34	2	79	1	45	1	22	1	22	....	....	....	....
	1,000-2,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
IV	0- 500	7	52	7	56	3	63	1	45	1	45	....	....	....	....	....	....
	500-1,000	12	45	12	39	9	48	6	64	3	68	....	....	....	....	....	....
	1,000-2,000	7	35	7	30	6	38	4	17	2	0	1	0	1	22	1	22
V	0- 500	4	45	4	76	4	62	4	56	....	....	....	....	....	....	....	....
	500-1,000	15	40	15	37	13	48	4	40	4	34	1	22	....	....	....	....
	1,000-2,000	26	5	26	7	26	15	10	25	3	13	....	....	....	....	....	....
VI	0- 500	10	43	9	24	9	26	8	16	4	9	....	....	....	....	....	....
	500-1,000	31	34	31	36	30	36	20	10	9	25	2	−11	1	0	....	....
	1,000-2,000	10	36	10	23	10	32	7	16	2	34	....	....	....	....	....	....
VII	0- 500	6	34	6	−12	5	− 12	1	−22	....	....	....	....	....	....	....	....
	500-1,000	18	−8	18	−14	17	− 8	8	−14	4	20	1	−22	1	−22	....	....
	1,000 2,000	11	30	11	− 4	9	− 6	4	1	....	....	....	....	....	....	....	....
VIII	0- 500	6	4	6	−20	4	− 32	2	32	....	....	....	....	....	....	....	....
	500-1,000	5	74	5	10	4	− 22	1	−22	1	−45	....	....	....	....	....	....
	1,000-2,000	2	....	2	−68	2	−102	....	....	....	....	....	....	....	....	....	....

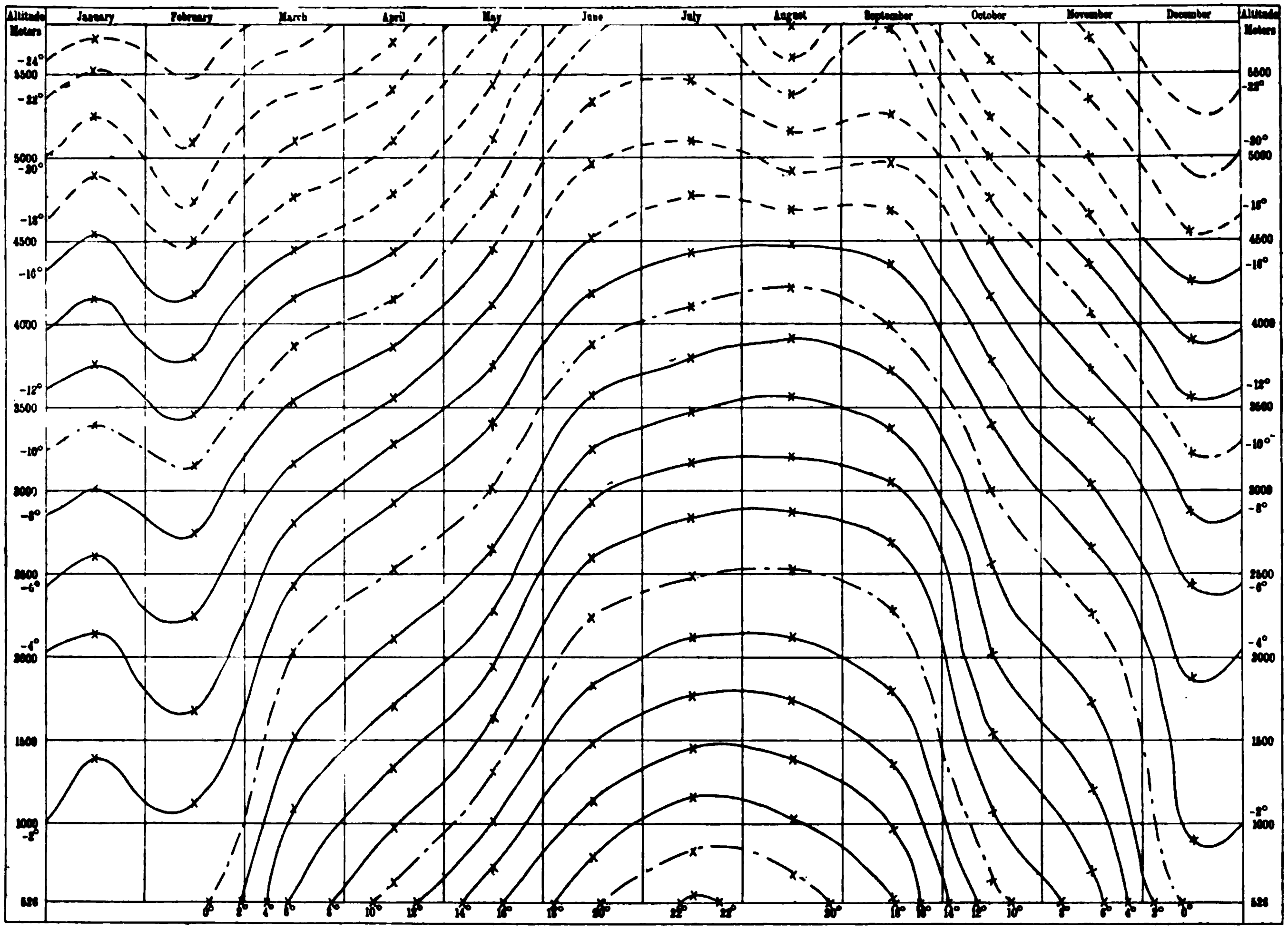
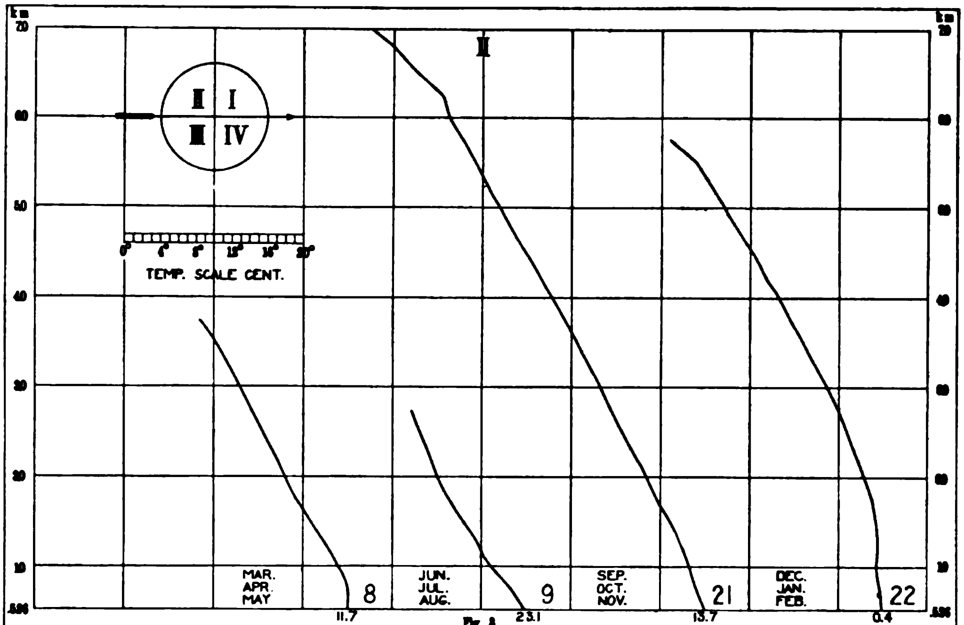


FIG. 1.—Mean free-air temperatures, July 1, 1907–June 30, 1910.


km
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60
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40
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20
10
.526
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II I
III IV
0° 4° 8° 12° 16° 20°
TEMP. SCALE CENT.
MAR.
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8
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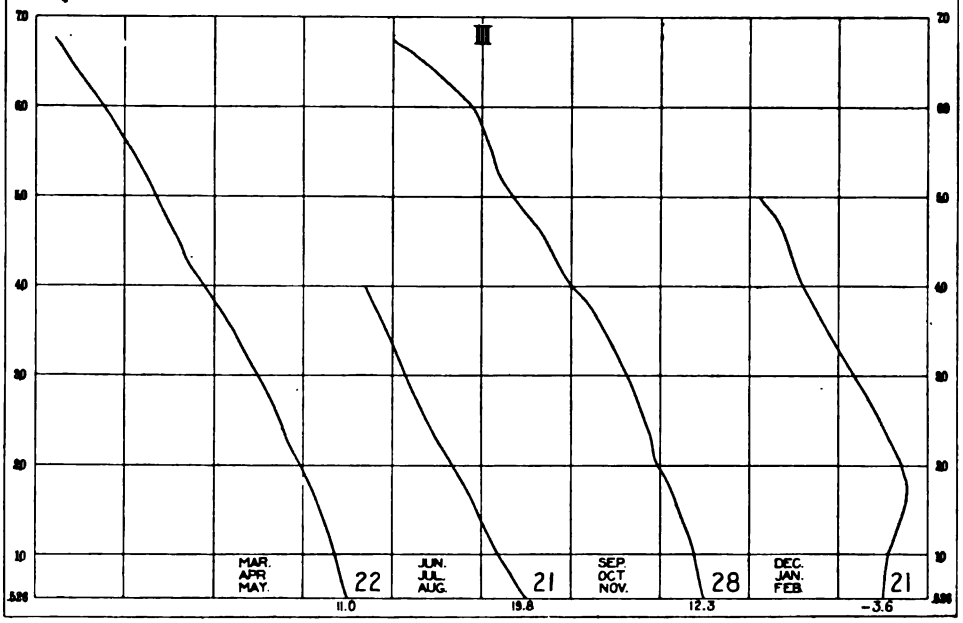
JUN.
JUL.
AUG.
9
23.1
SEP.
OCT.
NOV.
21
13.7
DEC.
JAN.
FEB.
22
0.4

Fig. 3.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JUN.
JUL.
AUG.
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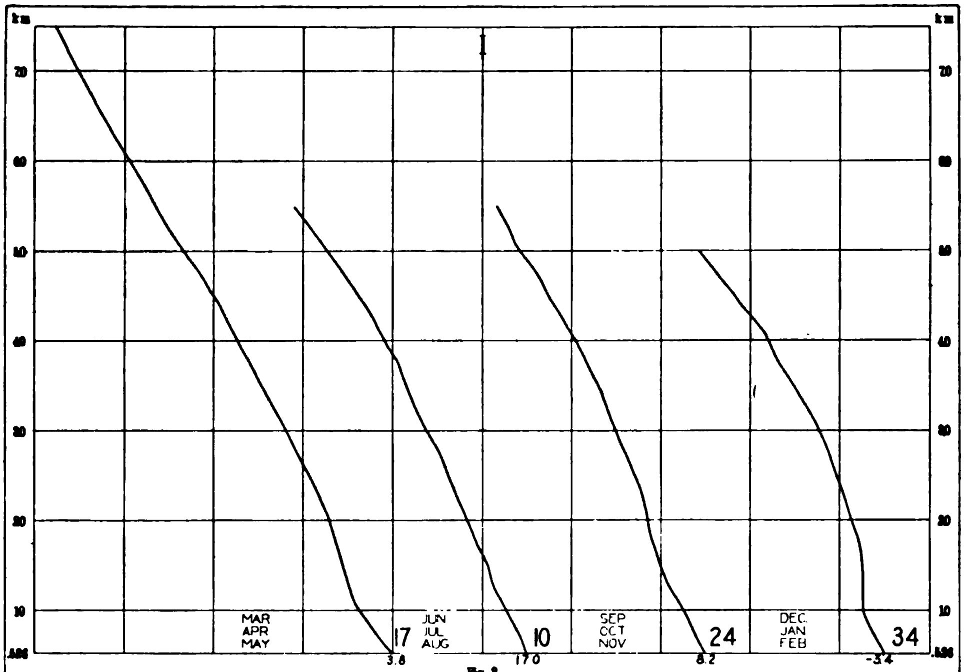
19.8
SEP.
OCT.
NOV.
28
12.3
DEC.
JAN.
FEB.
21
-3.6

Fig. 4.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.186
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JUN JUL AUG
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SEP OCT NOV
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DEC JAN FEB
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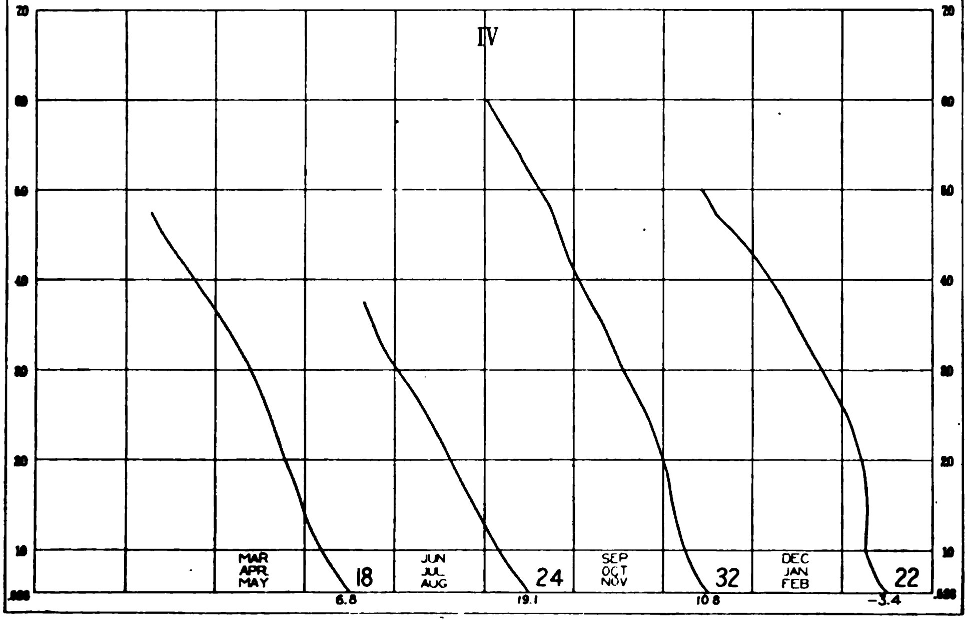
-3.4

Fig. 2.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IV
MAR APR MAY
18
6.8
JUN JUL AUG
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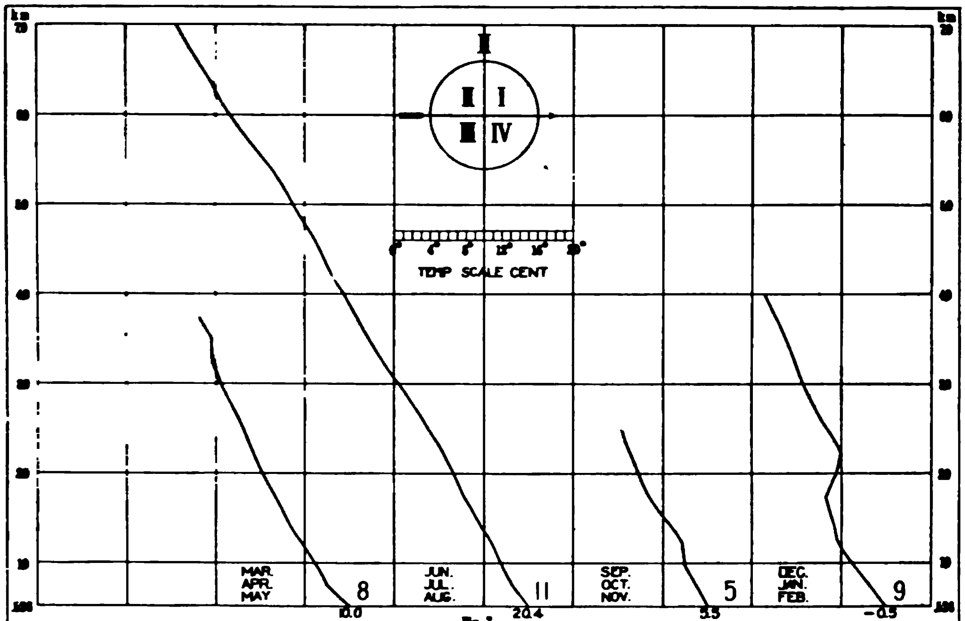
19.1
SEP OCT NOV
32
10.8
DEC JAN FEB
22
-3.4

Fig. 5.


km
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30
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10
.526
II
II I
III IV
0° 4° 8° 12° 16° 20°
TEMP SCALE CENT
MAR.
APR.
MAY
8
10.0
JUN.
JUL.
AUG.
11
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OCT.
NOV.
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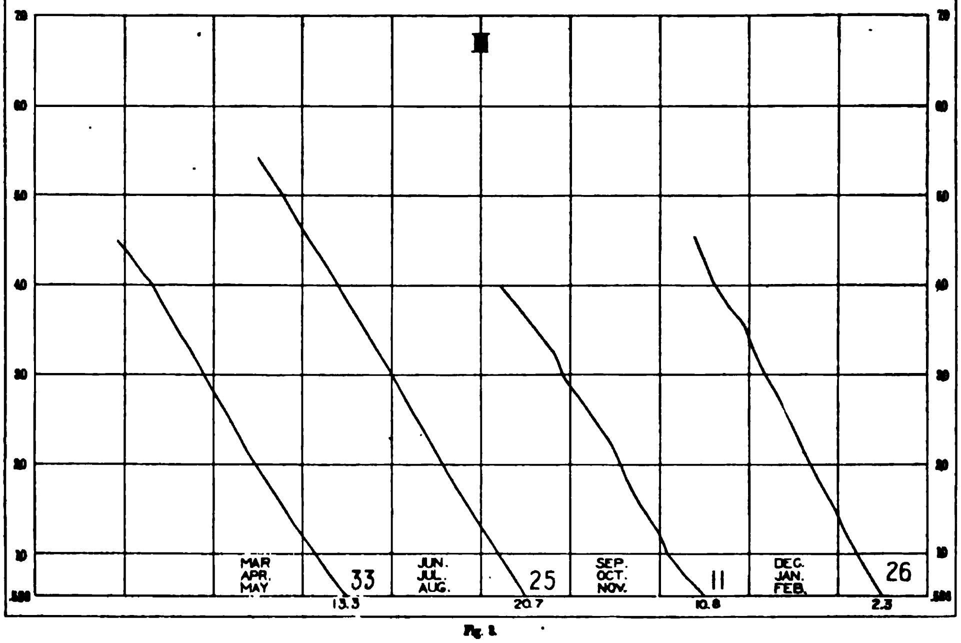
5.5
DEC.
JAN.
FEB.
9
-0.5

Fig. 1.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FEB.
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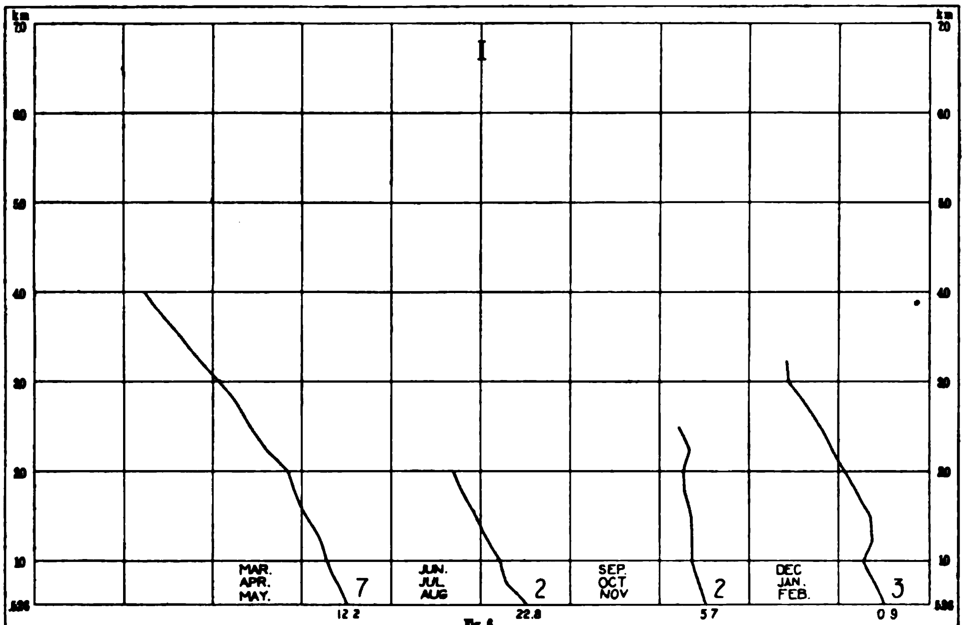
2.3

Fig. 2.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22.8
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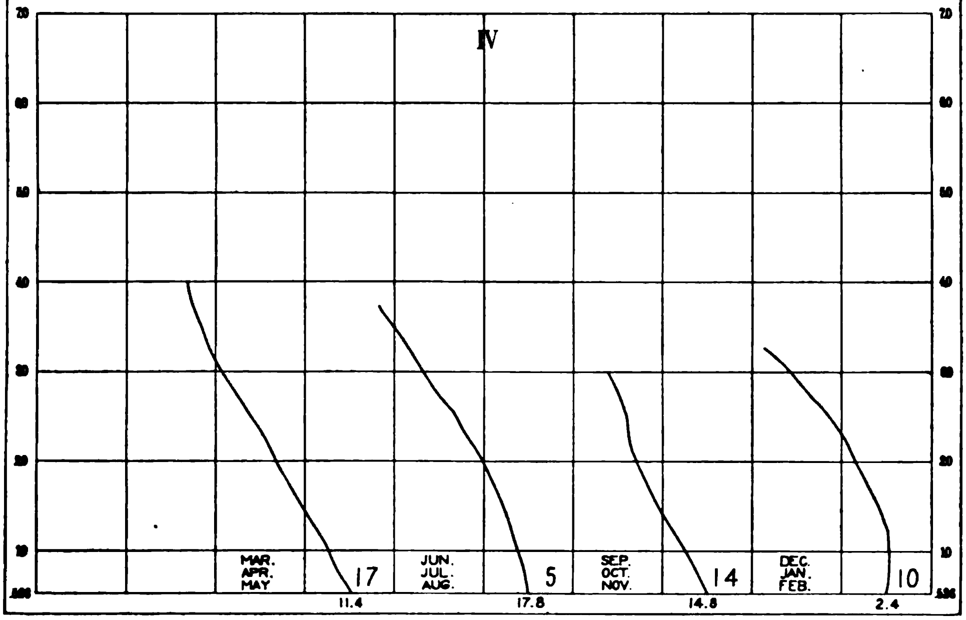
Fig. 8.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MAY
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JUN.
JUL.
AUG.
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SEP.
OCT.
NOV.
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DEC.
JAN.
FEB.
10
11.4
17.8
14.8
2.4

Fig. 9

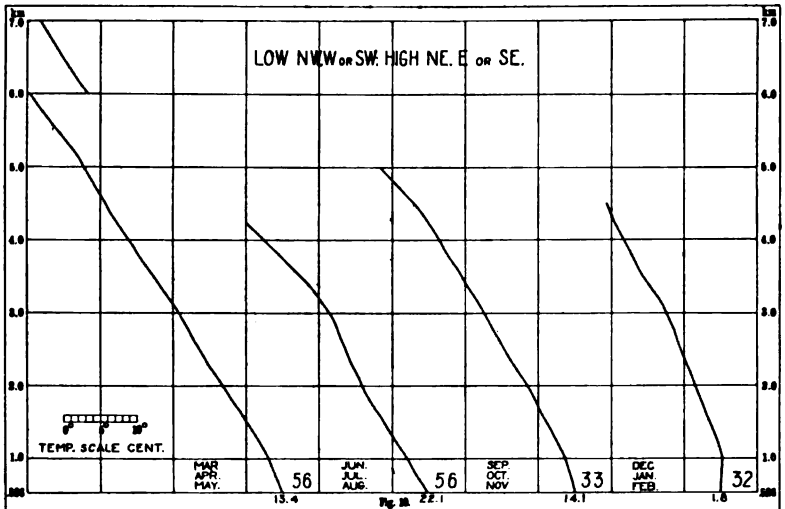

Fig. 10.

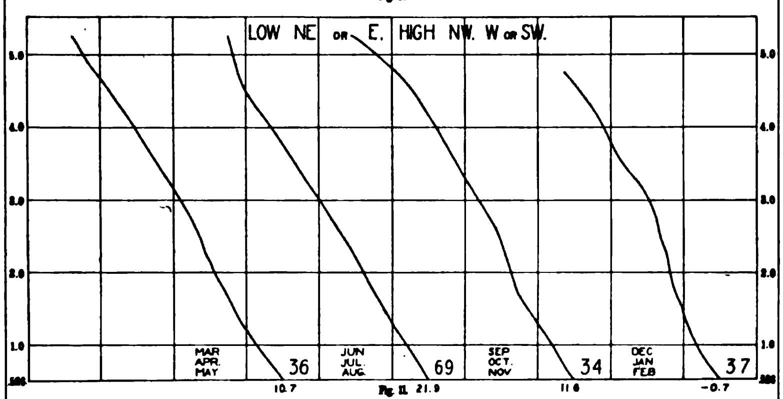

Fig. 11.

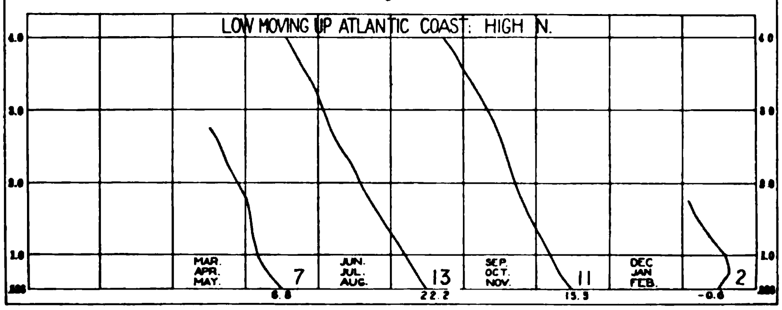

Fig. 12.

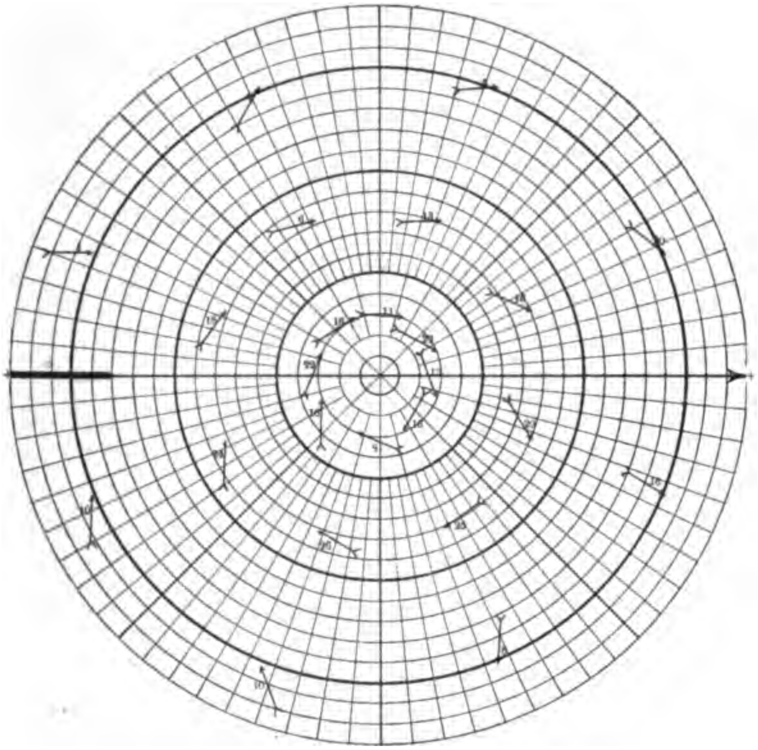

FIG. 14.—Means of wind observations in highs at 1,000 meters above sea level, 1907-1910.

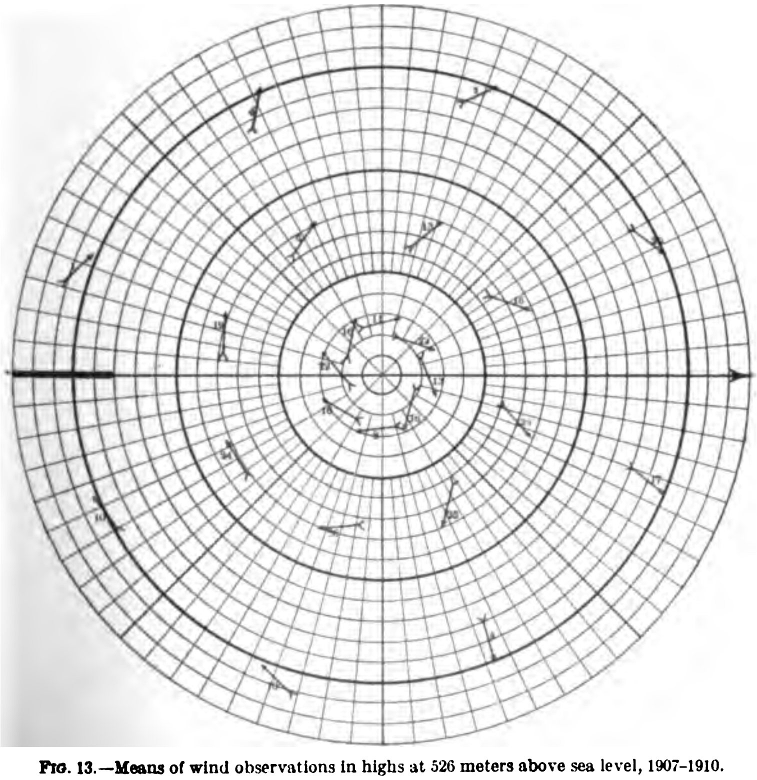

FIG. 13.—Means of wind observations in highs at 526 meters above sea level, 1907-1910.

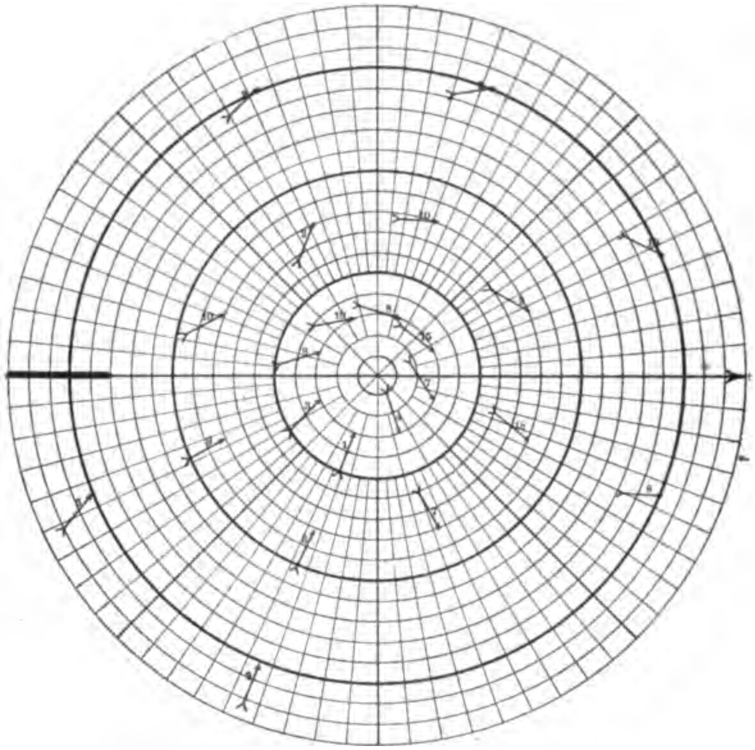

FIG. 16. –Means of wind observations in highs at 3,000 meters above sea level, 1907-1910.

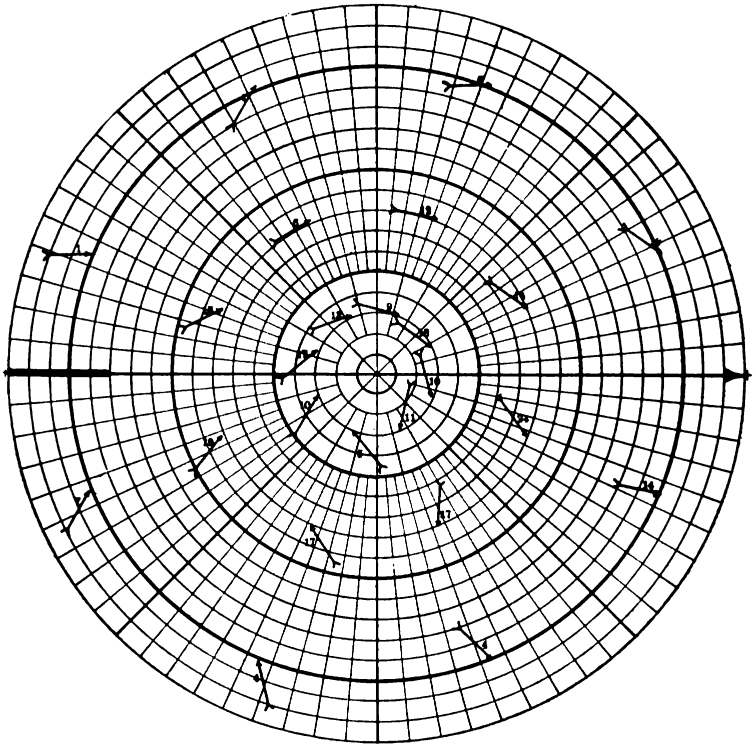

FIG. 15. –Means of wind observations in highs at 2,000 meters above sea level, 1907-1910.

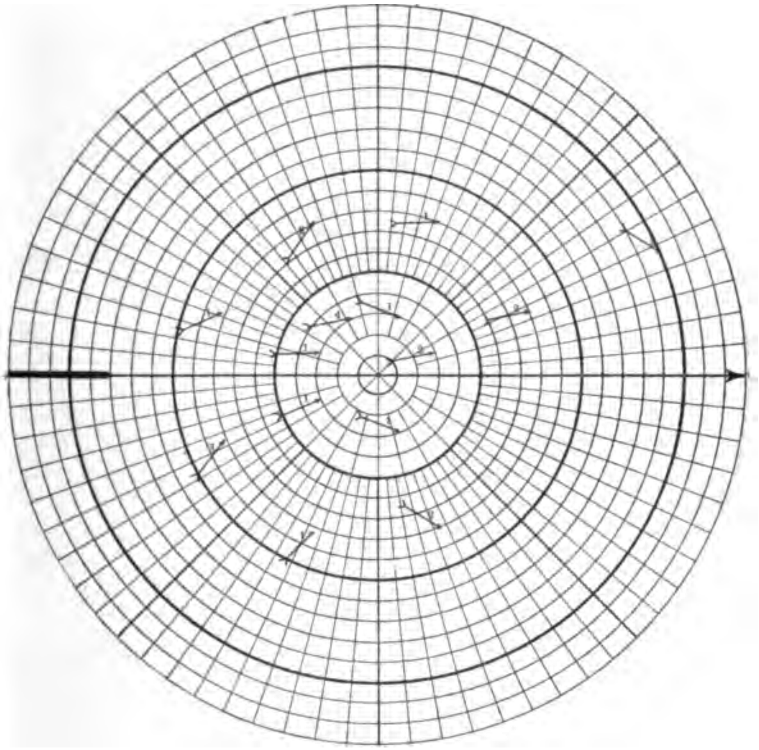

Fig. 18.—Means of wind observations in highs at 5,000 meters above sea level, 1907-1910.

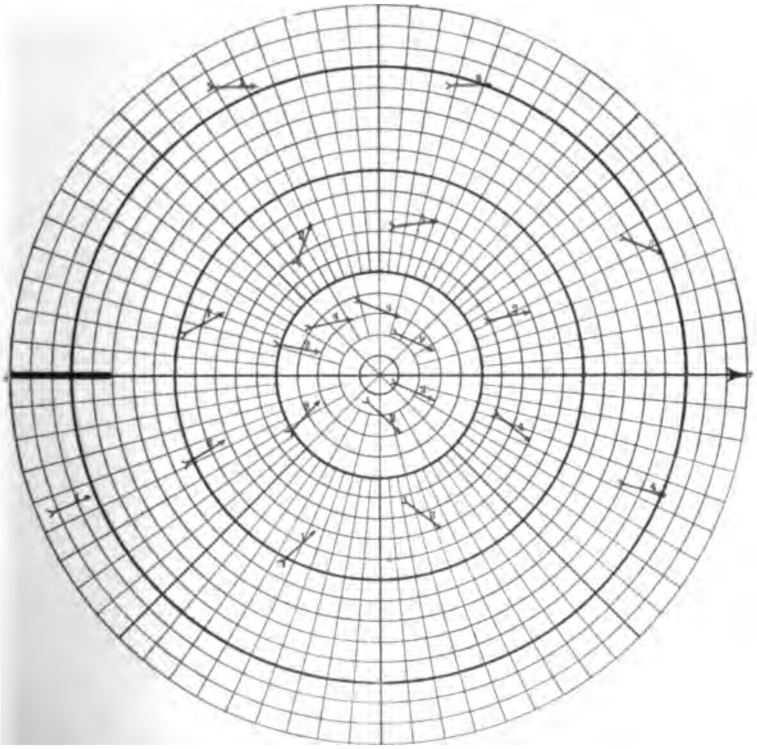

Fig. 17.—Means of wind observations in highs at 4,000 meters above sea level, 1907-1910.

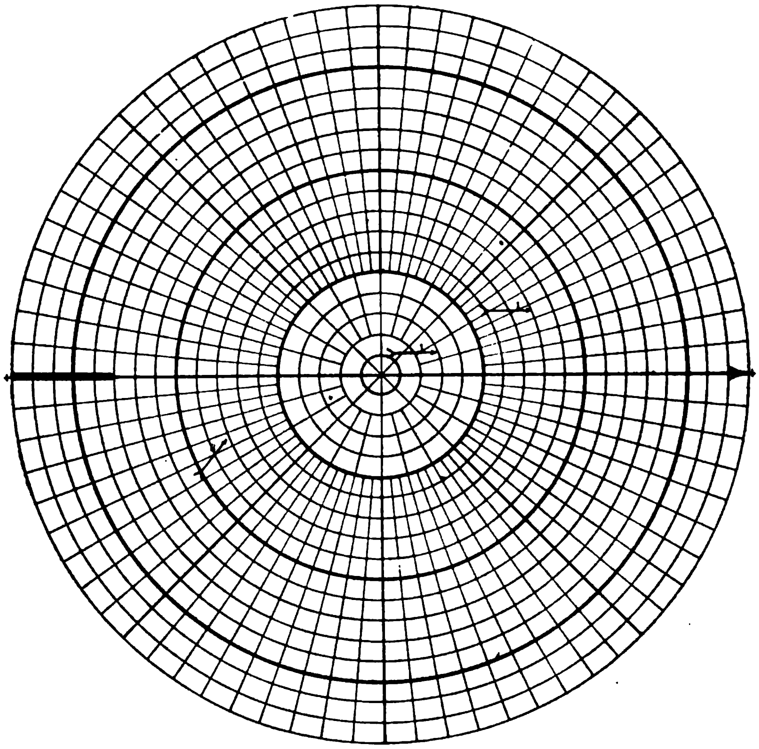

Fig. 20.—Means of wind observations in highs at 7,000 meters above sea level, 1907-1910.

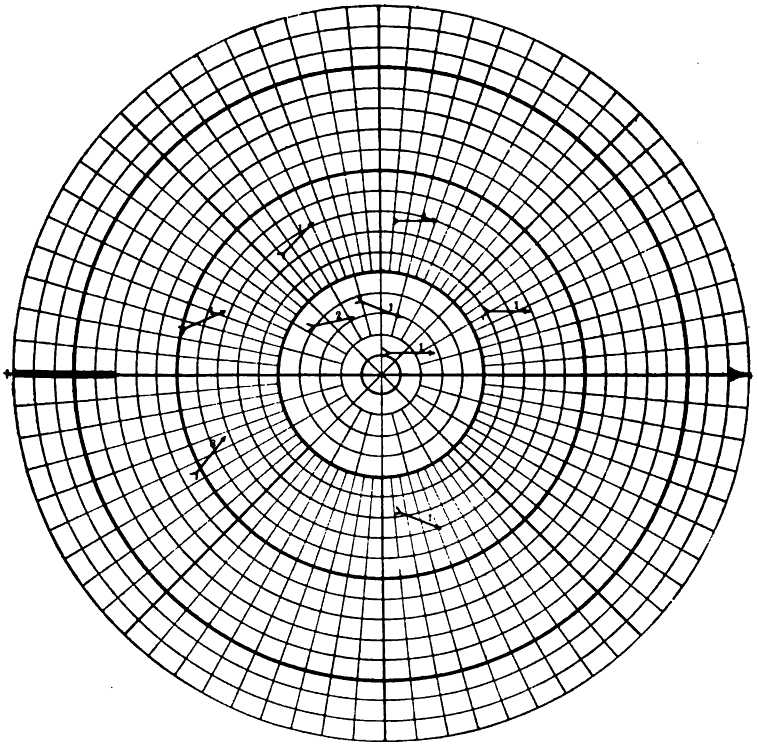

Fig. 19.—Means of wind observations in highs at 6,000 meters above sea level, 1907-1910.

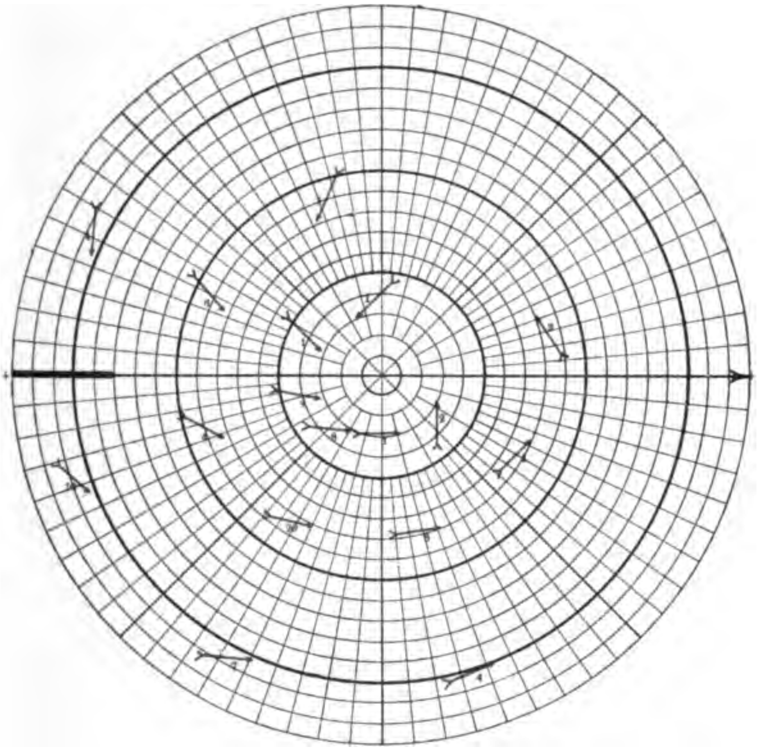

FIG. 22.—Means of wind observations in lows at 1,000 meters above sea level, 1907-1910.

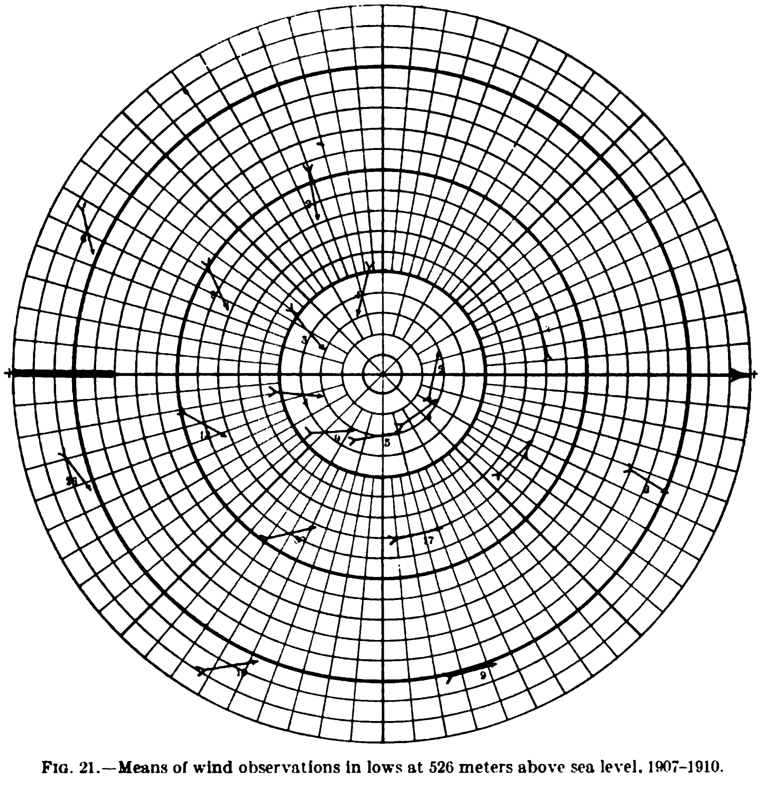

FIG. 21.—Means of wind observations in lows at 526 meters above sea level, 1907-1910.

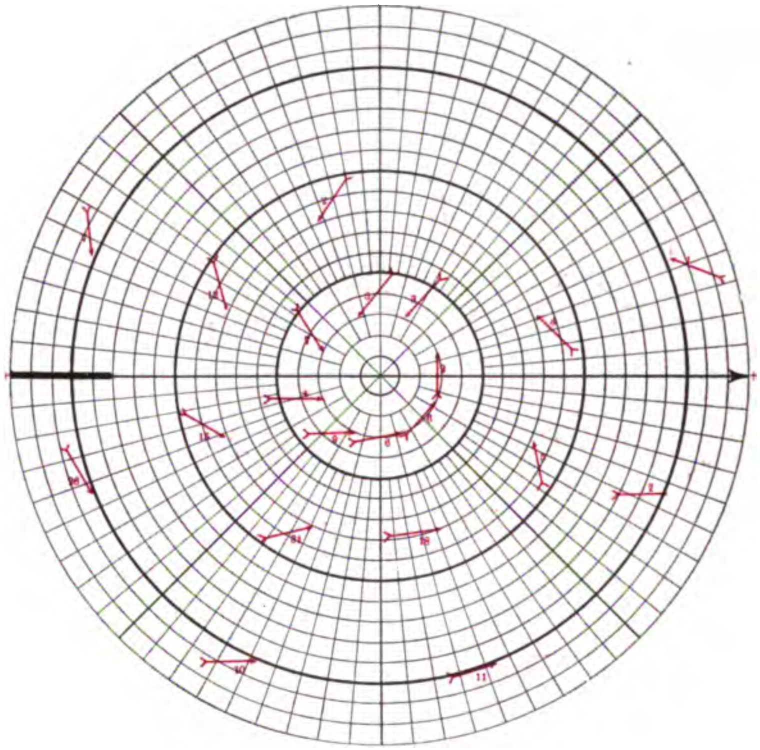

FIG. 24.—Means of wind observations in lows at 3,000 meters above sea level, 1907-1910.

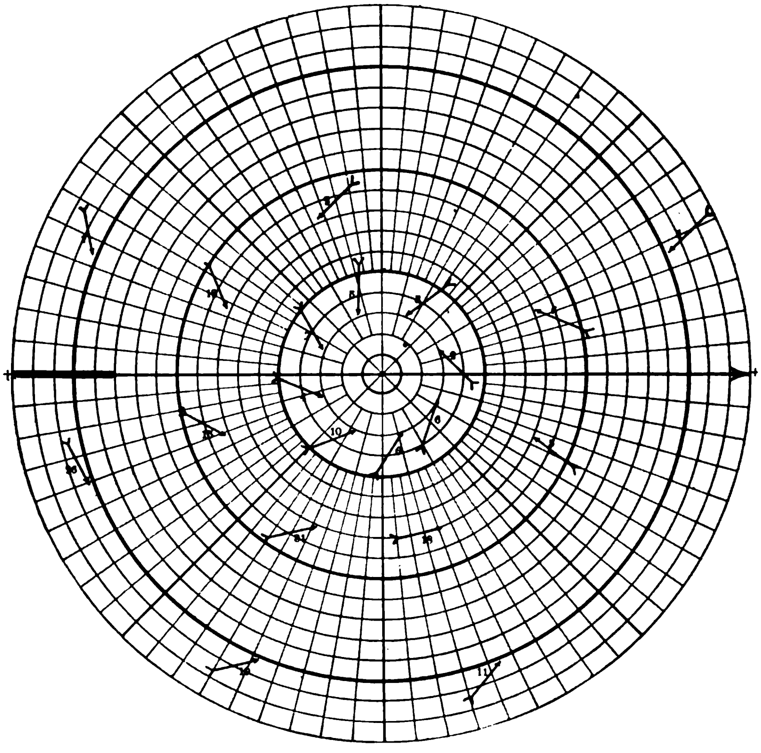

FIG. 23.—Means of wind observations in lows at 2,000 meters above sea level, 1907-1910.

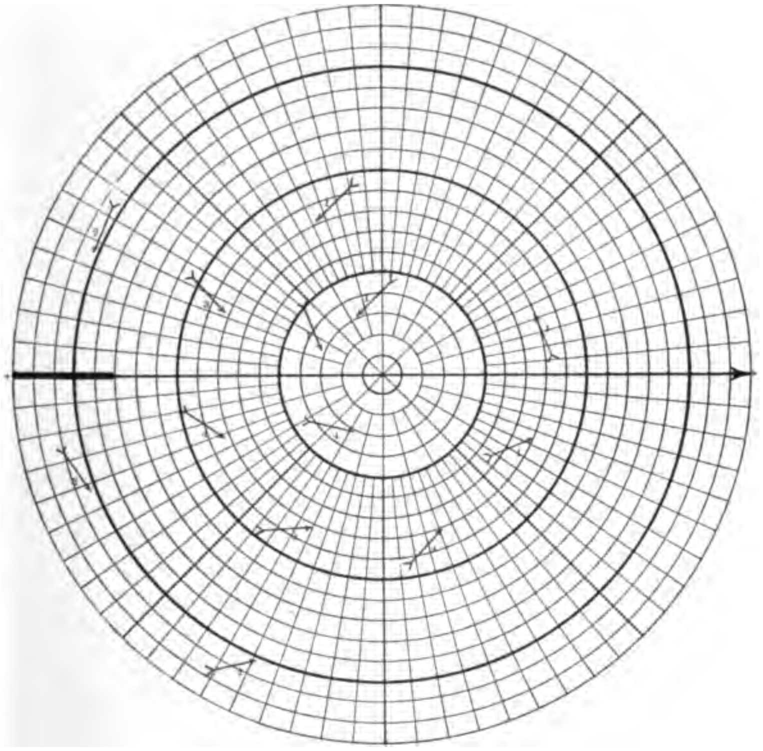

FIG. 25.—Means of wind observations in lows at 4,000 meters above sea level, 1907-1910.

(VII) FREE AIR DATA AT MOUNT WEATHER FOR JANUARY, FEBRUARY, AND MARCH, 1911

By the Aerial Section—William R. Blair in charge.

(Dated May 2, 1911.)

In the 90 days of this period 83 kite flights and 3 captive balloon ascensions were made. The average altitude reached with the kites in January was 2972 meters above sea level; in February, 2618; in March, 3034; and in the period, 2883. The highest flight, 4972 meters above sea level, was made on March 3. The captive balloon ascensions average 1701 meters above sea level, the highest, made on January 18, being 2436 meters above sea level. No free-air observations were made on January 1, 9, 17, 22, and February 8; on January 9, the wind was too high, while on the other four days it was too low for kites, and gas was not available for the captive balloons.

The prevailing wind direction for the period was west, more decidedly so in February and March than in January. The mean wind velocity in January was 8.5 meters per second, in February, 9.2, and in March, 9.9.

The charts of free air isotherms, I to VI, based on the observations of this period show the usual turbulent condition of the lower or moist stratum of the atmosphere in the winter months. Inversions of temperature were observed in 76 of the 86 ascensions made, a somewhat greater number than for the same period of last year. The remarks on page 40 of Volume III may be referred to in this connection. That the vertical temperature gradient actually changes sign may not be of more interest at one time than is its becoming small without change of sign at another time, so far as indicating a certain disturbed condition is concerned. The amount of change in the gradient seems to be a measure of the intensity of the disturbance.

The variations in the surface pressure are less regular than for these months of last year and the winter conditions continue through March.

The simultaneous wind directions at the surface and at the highest point reached in each flight are shown at the top of the Charts I to VI. The upper red arrow points in the direction of the air movem
aloft; the lower arrow shows that at th
are shown to 16 points in accord with usual

mapping directions. In most cases the change in wind direction with altitude is in the same sense from the surface to the top of the flight. There are a few instances in the three months, viz, January 23, 26, February 19 and 25, in which this is not the case. Wind directions at all levels are given in the tabulated data.

The hourly means of the surface temperatures at the mountain and valley stations are shown in figures 1, 2, and 3. The monthly mean temperatures for January and February at Mount Weather are, respectively, 3.1° and 1.2° higher this year than last, while the mean for March is 7.5° lower. The mean daily range of temperature for January and February of this year at Mount Weather is higher than for last year by 0.8° and 0.5°, respectively; for March it is 1.4° lower. The mean temperature for January at Mount Weather, 1.4°, is, respectively, 5° higher, 0.7° higher, and 0.1° lower than the means for December, 1910, and February and March, 1911.

The table of cloudiness for the period is as follows:

Month.	Number of days—			Mean Cloudiness, in tenths.
	Clear.	Partly cloudy.	Cloudy.	
				Tenths.
January	14	7	10	5.9
February	11	9	8	6.0
March	12	9	10	5.4

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
January 2:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7:28 a. m.	717.3	6.6	100	s.	10.7	526	717.3	6.6	100	s.	10.7
8:37 a. m.	717.5	7.3	98	s.	10.7	970	680.3	13.0	......	sw.	....
8:48 a. m.	717.6	8.8	96	s.	9.8	1536	636.1	10.2	......	sw.	....
9:07 a. m.	717.7	8.2	98	s.	10.7	2140	591.5	6.2	......	sw.	....
9:17 a. m.	717.8	9.1	100	ssw.	10.7	2501	566.0	4.2	......	sw.	....
9:48 a. m.	717.9	9.8	100	ssw.	10.7	526	717.9	9.8	100	ssw.	10.7

January 2.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4600 m., at maximum altitude.

There were 10/10 St.-Cu. from the southwest. Fog at intervals. Rain began at 9:30 a. m.

A storm of considerable energy was central over the upper Lake region while extreme high pressure covered the northern plains region. Pressure was also high off the Atlantic coast.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
January 3:											
4:40 p. m.	710.0	— 0.6	100	nw.	13.4	526	710.0	— 0.6	100	nw.	13.4
4:44 p. m.	710.0	— 0.6	100	nw.	13.4	636	700.2	— 2.5	......	nw.	....
5:00 p. m.	710.1	— 0.6	100	nw.	12.5	820	684.5	2.0	......	nw.	....
5:08 p. m.	710.1	— 0.6	100	nw.	12.5	637	700.2	— 2.7	......	nw.	....
5:11 p. m.	710.1	— 0.6	100	nw.	12.5	526	710.1	— 0.6	100	nw.	12.5

January 3.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 1000 m.; at maximum altitude, 600 m.

There were dense fog and light rain during the flight. Both kites, when landed, were heavily coated with ice.

At 8 a. m. a trough of low pressure extended from Georgia to New England and a high was central over Texas.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
January 4:											
8:52 a. m.	719.9	—10.2	93	nw.	9.8	526	719.9	—10.2	93	nw.	9.8
8:54 a. m.	719.9	—10.2	93	nw.	10.3	879	687.4	—14.3	......	nw.	....
9:00 a. m.	720.0	—10.1	93	nw.	8.9	945	681.5	—16.1	......	nw.	....
9:20 a. m.	720.2	— 9.9	88	nw.	11.6	1394	642.8	— 8.9	......	nnw.	....
10:02 a. m.	720.5	— 9.2	84	nw.	12.5	961	681.5	— 3.7	......	n.	....
10:14 a. m.	720.5	— 9.2	84	nw.	12.5	1679	620.3	—10.6	......	n.	....
10:22 a. m.	720.4	— 9.2	88	wnw.	12.5	1036	675.3	— 4.4	......	n.	....
10:26 a. m.	720.4	— 9.2	88	nw.	13.4	736	701.4	— 1.4	......	n.	....
10:41 a. m.	720.4	— 9.2	88	nw.	14.3	1386	644.8	— 8.8	......	n.	....
11:12 a. m.	720.3	— 9.0	81	wnw.	16.5	1024	675.3	— 4.2	......	nnw.	....
11:24 a. m.	720.2	— 8.5	79	wnw.	16.5	817	693.5	—12.7	......	nw.	....
11:30 a. m.	720.2	— 8.8	78	wnw.	14.3	526	720.2	— 8.8	78	wnw.	14.3

January 4.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 3600 m.; at maximum altitude, 3000 m.

There were 6/10 to 2/10 St.-Cu. from the northwest. The head kite was in clouds at 9:02 a. m.; altitude about 1000 m. Light snow fell from 10:07 to 10:10, and 10:35 to 10:40 a. m..

Low pressure was central over Lake Superior. High pressure extended northeastward from Louisiana to the St. Lawrence.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
January 5:											
8:34 a. m.	717.5	— 7.6	69	w.	7.2	526	717.5	— 7.6	69	w.	7.2
10:33 a. m.	717.8	— 6.2	57	wnw.	13.4	780	694.8	—10.3	......	wnw.	....
10:57 a. m.	717.8	— 6.0	49	wnw.	12.1	1163	660.9	—13.0	......	wnw.	....
11:10 a. m.	717.8	— 5.8	50	wnw.	14.3	1548	628.2	—15.5	......	wnw.	....
11:26 a. m.	717.8	— 5.7	50	wnw.	12.5	1938	596.5	—15.9	......	wnw.	....
11:35 a. m.	717.8	— 5.6	50	wnw.	12.5	2280	570.4	—13.0	......	wnw.	....
11:40 a. m.	717.8	— 5.4	50	wnw.	13.4	1941	596.5	—16.0	......	wnw.	....
12:04 p. m.	717.8	— 4.9	48	wnw.	14.3	1508	631.7	—14.3	......	wnw.	....
12:14 p. m.	717.8	— 5.2	46	wnw.	13.4	1144	662.7	—12.6	......	wnw.	....
12:24 p. m.	717.8	— 4.7	45	wnw.	11.6	838	689.6	— 9.9	......	wnw.	....
12:30 p. m.	717.8	— 4.6	44	wnw.	11.6	526	717.8	— 4.6	44	wnw.	11.6

January 5.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5000 m., at maximum altitude.

The sky was cloudless until 12:03 p. m., when a few A.-St. from the west appeared.

Low pressure was central north of Lake Ontario. Pressure was high over the Gulf coast from Texas to Alabama.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Re. Hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. January 6:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:21 a. m......	718.8	− 4.0	......	s.	7.6	526	718.8	− 4.0	......	s.	7.6
8:28 a. m......	718.8	− 3.4	......	s.	7.2	733	700.4	1.4	......	sw.	....
8:37 a. m......	718.9	− 2.4	46	s.	7.6	1030	675.2	0.6	......	sw.	....
9:00 a. m......	718.9	− 1.7	69	ssw.	4.9	1567	631.2	− 4.0	......	sw.	....
9:16 a. m......	718.9	− 1.8	67	ssw.	6.3	2192	582.9	− 7.5	......	sw.	....
9:29 a. m......	718.9	− 1.6	45	ssw.	4.9	2413	566.5	− 7.5	......	sw.	....
10:13 a. m......	718.7	− 0.1	44	s.	7.2	3608	484.9	−13.9	......	sw.	....
11:06 a. m......	718.0	− 0.5	54	s.	4.5	2696	545.5	− 9.1	......	sw.	....
11:50 a. m......	717.4	1.2	46	s.	4.5	2298	573.8	− 6.2	......	sw.	....
12:15 p. m.....	717.2	1.5	50	s.	4.9	1548	631.2	− 3.4	......	sw.	....
12:34 p. m.....	717.1	1.9	46	s.	4.9	944	680.8	0.1	......	sw.	....
12:39 p. m.....	717.1	2.3	45	s.	5.4	526	717.1	2.3	45	s.	5.4

January 6.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 7000 m., at maximum altitude.

There were 9/10 Ci.-St. and A.-St., from the west-southwest, until 11 a. m., and 2/10 at the end of the flight.

Pressure was high over the Atlantic coast and was low over the Lakes.

January 7:											
7:55 a. m......	718.3	0.0	64	w.	6.3	526	718.3	0.0	64	w.	6.3
8:04 a. m......	718.3	0.2	58	w.	6.3	974	679.2	− 1.5	......	w.	....
8:20 a. m......	718.4	0.7	68	w.	6.3	1509	635.0	− 3.8	......	w.	....
8:42 a. m......	718.4	1.0	65	wsw.	6.3	2400	566.7	− 9.5	......	w.	....
8:57 a. m......	718.5	1.5	66	wsw.	7.2	3035	521.9	−13.0	......	w.	....
9:03 a. m......	718.5	1.6	60	wsw.	7.2	3270	506.1	−12.7	......	w.	....
9:50 a. m......	718.9	2.9	52	wsw.	7.2	3924	465.2	−14.5	......	w.	....
10:30 a. m......	718.7	4.0	49	wsw.	7.6	3312	504.3	−11.4	......	w.	....
10:43 a. m......	718.6	4.3	51	wsw.	7.2	2779	540.2	− 7.3	......	w.	....
10:56 a. m......	718.5	4.4	57	wsw.	7.6	2455	563.1	− 9.3	......	w.	....
11:21 a. m......	718.3	4.5	44	wsw.	8.0	1513	635.0	− 3.6	......	w.	....
11:31 a. m......	718.1	4.4	44	wsw.	7.6	956	680.9	0.0	......	wsw.	....
11:35 a. m......	718.1	4.5	44	wsw.	7.6	526	718.1	4.5	44	wsw.	7.6

January 7.—Five kites were used; lifting surface 31.5 sq. m. Wire out, 7000 m.; at maximum altitude, 6400 m.

There were 8/10 Ci.-St. and A.-St. from the west, with solar halo after 9:30 a. m.

At 8 a. m. pressure was low north of the Lake region and high over the Gulf of St. Lawrence and the Southeastern States.

January 8:											
8:12 a. m......	713.2	3.2	58	ssw.	6.3	526	713.2	3.2	58	ssw.	6.3
8:20 a. m......	713.1	3.6	59	sw.	5.8	808	688.8	4.5	......	sw.	....
8:31 a. m......	713.1	4.9	57	sw.	5.4	1355	643.9	0.0	......	sw.	....
9:00 a. m......	713.0	4.1	57	ssw.	4.5	2018	592.2	− 4.4	......	wsw.	....
9:34 a. m......	712.5	5.3	56	ssw.	5.8	2575	551.5	− 7.5	......	wsw.	....
9:55 a. m......	712.3	5.7	53	ssw.	5.4	3561	485.4	−10.8	......	sw.	....
10:55 a. m......	711.6	3.6	67	se.	4.9	4288	440.7	−15.4	......	wsw.	....
12:04 p. m.....	710.6	4.5	61	se.	6.3	3384	496.4	− 9.8	......	wsw.	....
12:26 p. m.....	710.4	3.8	65	se.	7.2	2329	567.9	− 3.0	......	wsw.	....
12:48 p. m.....	710.1	3.4	66	se.	4.5	1968	594.0	− 1.1	......	wsw.	....
1:07 p. m.....	709.8	3.2	68	se.	5.8	1430	635.0	0.6	......	ssw.	....
1:19 p. m.....	709.7	3.2	68	sse.	7.2	811	685.3	5.1	......	s.	....
1:28 p. m.....	709.6	3.2	66	se.	8.0	526	709.6	3.2	66	se.	8.0

January 8.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 10000 m., at maximum altitude.

There were from 2/10 to 4/10 A.-Cu. from the west. About 12:30 p. m. St.-Cu. from the west-southwest began to form and by the end of the flight covered 8/10 of the sky. The head kite was in the clouds at intervals from 12:23 until 12:58 p. m. Light rain occurred from 1:13 to 1:15 p. m.

A well-developed low was central over southeastern Wisconsin. Pressure was relatively high off the Atlantic coast.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
January 10:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1:26 p. m.....	724.4	4.6	26	sse.	6.7	526	724.4	4.6	26	sse.	6.7
1:37 p. m.....	724.2	4.8	28	s.	7.2	911	690.6	1.1	......	s.	....
1:51 p. m.....	724.0	4.6	23	sse.	5.4	1340	654.4	0.5	......	ssw.	....
2:07 p. m.....	723.9	4.6	25	sse.	5.4	1575	635.6	1.9	......	sw.	....
3:02 p. m.....	723.6	4.7	38	sse.	5.4	1788	618.8	2.2	......	sw.	....
3:20 p. m.....	723.4	4.4	21	sse.	6.3	2642	556.4	− 0.5	......	wsw.	....
3:30 p. m.....	723.4	4.6	36	sse.	6.3	3216	517.7	− 3.0	......	wsw.	....
3:40 p. m.....	723.3	4.4	26	sse.	6.3	2870	540.8	− 2.5	......	wsw.	....
3:57 p. m.....	723.1	4.1	29	sse.	6.3	2333	578.2	0.3	......	wsw.	....
4:14 p. m.....	723.1	3.9	41	sse.	8.0	1685	626.6	1.9	......	sw.	....
4:18 p. m.....	723.1	3.8	31	sse.	8.0	1473	643.2	3.0	......	sw.	....
4:25 p. m.....	723.1	3.7	28	sse.	8.9	1092	674.2	2.8	......	s.	....
4:33 p. m.....	723.1	3.5	38	sse.	8.0	715	706.4	1.4	......	s.	....
4:36 p. m.....	723.1	3.4	33	sse.	8.0	526	723.1	3.4	33	sse.	8.0

January 10.—Five kites were used; lifting surface, 33.5 sq. m. Wire out, 5700 m.; at maximum altitude, 4900 m.

There were few Ci.-St. in the west after 2 p. m. Direction of clouds doubtful.

An extensive area of high pressure was central over the Carolinas and Virginia. Pressure was low over the middle Rocky Mountain district and the northern plains States.

January 11:											
8:02 a. m......	718.8	9.0	50	wsw.	7.6	526	718.8	9.0	50	wsw.	7.6
8:10 a. m......	718.8	9.2	51	sw.	8.5	868	689.9	10.4	......	w.	....
8:21 a. m......	718.8	9.5	53	wsw.	8.0	1458	642.5	7.1	......	w.	....
8:42 a. m......	718.8	9.9	57	wsw.	7.2	2304	579.3	1.8	......	w.	....
8:50 a. m......	718.8	10.0	58	wsw.	5.8	2355	575.7	6.5	......	w.	....
8:58 a. m......	718.8	10.0	60	sw.	4.9	2381	573.9	4.9	......	w.	....
9:11 a. m......	718.8	10.0	60	sw.	4.9	2540	562.9	8.5	......	w.	....
9:48 a. m......	718.9	10.5	63	sw.	4.5	2716	551.1	7.3	......	w.	....
10:08 a. m......	718.9	10.7	64	sw.	4.5	2433	570.2	8.4	......	w.	....
10:17 a. m......	718.9	10.2	62	wsw.	4.5	2251	583.0	3.3	......	w.	....
10:44 a. m......	718.9	10.0	62	wsw.	7.6	1410	646.1	5.7	......	w.	....
10:56 a. m......	718.9	10.2	62	wsw.	8.0	807	695.1	10.1	......	wsw.	....
10:58 a. m......	718.9	10.2	62	wsw.	7.6	526	718.9	10.2	62	wsw.	7.6

January 11.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 7000 m.; at maximum altitude, 6100 m.

Ci.-St. of indeterminate direction, A.-Cu. from the west-northwest, and St.-Cu. from the west, practically covered the sky until 9:30 a. m., when the upper clouds gave place to St.-Cu. The head kite was in St.-Cu. at intervals from 8:39 to 10:33 a. m.; altitude of base of lower stratum of St.-Cu. was about 2250 m.; that of the main stratum about 2600 m.

High pressure was central over the South Atlantic States. A trough of low pressure extended from Ontario to Oklahoma.

January 12:											
8:06 a. m......	718.6	13.9	77	w.	11.2	526	718.6	13.9	77	w.	11.2
8:13 a. m......	718.7	14.1	75	w.	11.6	895	688.0	13.0	......	w.	....
8:30 a. m......	718.9	13.6	79	w.	12.1	1282	657.1	10.2	......	wnw.	....
8:41 a. m......	719.0	13.6	78	w.	11.2	1769	619.8	8.3	......	wnw.	....
8:59 a. m......	719.2	13.8	77	w.	10.3	2254	584.7	6.7	......	wnw.	....
9:12 a. m......	719.2	13.4	78	w.	9.2	2644	557.4	4.2	......	wnw.	....
9:27 a. m......	719.3	13.6	80	w.	10.7	3312	513.3	0.0	......	wnw.	....
10:06 a. m......	719.4	14.4	80	w.	10.3	4101	465.0	−3.0	......	wnw.	....
10:59 a. m......	719.4	14.8	78	w.	9.8	3284	515.1	1.2	......	wnw.	....
11:22 a. m......	719.4	14.9	77	w.	8.5	2646	557.4	4.5	......	wnw.	....
11:42 a. m......	719.4	14.8	78	w.	7.6	2051	599.3	8.0	......	wnw.	....
11:49 a. m......	719.4	14.6	78	w.	7.6	1773	619.8	7.5	......	wnw.	....
12:03 p. m.....	719.4	14.2	79	w.	8.9	1242	660.7	10.2	......	w.	....
12:12 p. m.....	719.4	14.1	80	w.	9.8	882	689.7	12.4	......	w.	....
12:18 p. m.....	719.4	14.1	80	w.	10.3	526	719.4	14.1	80	w.	10.3

January 12.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 8000 m.; at maximum altitude, 7700 m.

The sky was overcast with St.-Cu. from the west-northwest, altitude of lowest layers being 1700 m. Light rain fell from 8:10 to 8:25 a. m.

At 8 a. m. pressure was high over the Gulf States and north of the lower Lakes and relatively low over the Middle Atlantic States.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
January 13:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1:35 p. m.	719.9	9.2	......	wsw.	5.4	526	719.9	9.2	......	wsw.	5.4
1:38 p. m.	719.9	9.6	92	w.	5.4	846	693.0	14.3	......	wsw.	....
1:58 p. m.	719.8	7.1	98	nw.	4.9	1756	621.3	8.5	......	w.	....
2:20 p. m.	719.8	6.4	100	nw.	5.4	2360	577.1	4.4	......	w.	....
2:37 p. m.	719.9	6.8	100	nw.	6.7	2677	555.2	2.6	......	w.	....
2:57 p. m.	719.9	6.4	100	nw.	5.4	3016	532.3	−0.1	......	w.	....
3:19 p. m.	720.0	6.7	99	w.	6.7	3372	509.2	−1.1	......	w.	....
3:49 p. m.	720.1	8.7	95	w.	5.4	1181	666.1	10.7	......	w.	....
3:59 p. m.	720.1	9.1	96	w.	5.4	1072	674.9	11.9	......	w.	....
4:16 p. m.	720.3	8.6	96	w.	6.7	639	710.7	13.7	......	w.	....
4:17 p. m.	730.3	8.5	96	w.	7.2	526	720.3	8.5	96	w.	7.2

January 13.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 6000 m.; at maximum altitude, 5700 m.

At the start there were 9/10 St. from the west, 7/10 to 9/10 St.-Cu. from the west prevailed after 2 p. m. Fog at intervals.

The pressure was high over Georgia and off the New England coast and comparatively low over New York and southern Missouri.

January 14:											
8:16 a. m.	717.6	14.6	73	wsw.	5.4	526	717.6	14.6	73	wsw.	5.4
8:26 a. m.	717.6	14.8	73	wsw.	4.5	973	680.7	13.0	......	w.	....
8:42 a. m.	717.6	13.8	80	wsw.	5.8	1602	631.2	8.4	......	w.	....
9:02 a. m.	717.6	14.5	76	wsw.	6.3	2335	577.4	3.7	......	w.	....
9:06 a. m.	717.6	14.6	75	wsw.	6.3	2439	570.1	7.0	......	w.	....
9:33 a. m.	717.6	15.0	71	wsw.	8.0	2883	540.0	4.8	......	w.	....
10:17 a. m.	717.5	14.8	71	wsw.	8.0	3548	497.4	−0.6	......	w.	....
10:40 a. m.	717.4	15.0	71	wsw.	8.0	2619	557.4	5.3	......	w.	....
11:27 a. m.	716.8	15.8	65	wsw.	7.2	1938	605.4	5.3	......	w.	....
11:44 a. m.	716.6	16.0	63	wsw.	7.2	1446	642.4	9.0	......	w.	....
11:54 a. m.	716.4	16.0	63	wsw.	7.2	938	682.5	13.3	......	w.	....
11:59 a. m.	716.3	16.4	61	wsw.	7.2	526	716.3	16.4	61	wsw.	7.2

January 14.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 8000 m., at maximum altitude.

About 3/10 A.-St. and 7/10 St.-Cu. from the west; decreased to 1/10 A.-St. and 4/10 St.-Cu. by the end of the flight.

Low pressure was central over the lower Lakes. High pressure was central over Georgia.

January 15:											
10:00 a. m.	711.3	10.0	95	wnw.	5.4	526	711.3	10.0	95	wnw.	5.4
10:11 a. m.	711.2	10.2	93	wnw.	5.4	1017	670.3	7.7	......	wnw.	....
10:24 a. m.	711.0	10.4	93	wnw.	6.7	1517	630.6	5.1	......	wnw.	....
10:43 a. m.	710.7	10.4	89	wnw.	8.9	1962	596.8	2.2	......	wnw.	....
10:48 a. m.	710.7	10.4	88	wnw.	10.3	2246	576.2	1.3	......	wnw.	....
11:05 a. m.	710.4	10.5	87	wnw.	9.4	1632	621.2	5.2	......	wnw.	....
11:37 a. m.	710.0	11.0	85	wnw.	8.5	1437	635.9	4.9	......	wnw.	....
11:48 a. m.	709.8	11.2	80	wnw.	13.4	1045	666.8	8.0	......	wnw.	....
12:03 p. m.	709.7	11.4	74	nw.	14.3	526	709.7	11.4	74	nw.	14.3

January 15.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4100 m.; at maximum altitude, 3600 m.

There were 10/10 St.-Cu. from the west-northwest. The head kite was in the clouds at intervals from 10:23 to 11:31 a. m.

Pressure was high over South Dakota and low over New Brunswick with a secondary depression over Maryland.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.
1911.											
January 16:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
9:57 a. m......	722.6	−6.1	46	nw.	14.8	526	722.6	− 6.1	46	nw.	14.8
10:08 a. m......	722.6	−6.4	48	nw.	17.9	960	684.1	−11.8	......	nnw.	....
10:17 a. m......	722.5	−7.4	61	nw.	19.7	1318	651.6	−13.3	......	nnw.	....
10:23 a. m......	722.4	−7.4	61	nw.	19.7	1668	622.8	− 8.8	......	nnw.	....
10:33 a. m......	722.3	−7.3	61	nw.	17.9	2088	589.9	−10.1	......	nnw.	....
10:45 a. m......	722.2	−7.1	62	nw.	11.6	2960	525.2	−12.8	......	nnw.	....
11:22 a. m......	722.1	−7.2	57	nw.	16.1	2288	577.2	− 9.3	......	nnw.	....
11:48 a. m......	722.2	−7.0	56	nw.	12.1	1829	608.8	−12.1	......	nnw.	....
11:59 a. m......	722.2	−6.7	56	nw.	13.4	1586	632.8	−16.1	......	nnw.	....
12:00 p. m......	722.2	−7.0	51	nw.	15.2	945	684.1	−12.1	......	nw.	....
12:15 p. m......	722.2	−6.8	52	nw.	11.2	526	722.2	− 6.8	52	nw.	11.2

January 16.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5000 m.; at maximum altitude.

There were 1/10 to 3/10 St.-Cu. from the north-northwest and, after 11:30 a. m., 2/10 to 4/10 Ci.-St. from the northwest.

At 8 a. m. an extensive high was central over Minnesota and a low over the Gulf of St. Lawrence.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.
January 18:											
4:31 p. m......	723.0	−4.0	68	se.	3.1	526	723.0	−4.0	68	se.	3.1
4:50 p. m......	723.0	−4.4	68	se.	2.7	2436	566.5	−4.1	......	s.	....
5:04 p. m......	723.0	−4.8	71	se.	2.7	1844	610.8	−6.6	......	s.	....
5:13 p. m......	723.0	−4.8	71	se.	3.1	1428	644.2	−7.0	......	s.	....
5:17 p. m......	723.0	−4.9	73	se.	3.1	1122	669.9	−6.2	......	s.	....
5:20 p. m......	723.0	−5.0	76	se.	3.1	835	695.0	−7.5	......	se.	....
5:30 p. m......	723.0	−5.0	76	se.	3.1	526	723.0	−5.0	76	se.	3.1

January 18.—One balloon was used; capacity, 22.4 cu. m. Wire out, 2600 m. There was 1/10 St.-Cu. from the southwest.

Pressure was high over New England and low over Manitoba.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.
January 19:											
9:45 a. m........	718.2	−2.6	87	w.	5.4	526	718.2	− 2.6	87	w.	5.4
10:07 a. m........	718.1	−1.9	79	w.	6.3	896	685.4	− 3.7	......	wnw.	....
10:15 a. m........	718.0	−1.7	76	w.	5.4	1153	663.6	2.2	......	wnw.	....
10:37 a. m........	717.8	−0.8	77	w.	6.3	1379	645.3	3.8	......	wnw.	....
10:57 a. m........	717.6	−0.3	71	wsw.	6.3	1964	600.3	0.7	......	wnw.	....
11:25 a. m........	717.4	0.1	68	w.	9.8	2708	546.6	− 3.2	......	wnw.	....
11:38 a. m........	717.3	0.3	67	w.	7.2	3300	507.0	− 6.8	......	wnw.	....
11:42 a. m........	717.3	0.4	67	w.	7.2	3329	505.1	− 6.5	......	wnw.	....
11:49 a. m........	717.3	0.5	68	w.	8.0	3580	489.1	− 8.0	......	wnw.	....
11:54 a. m........	717.2	0.6	68	w.	8.0	3668	482.3	− 7.3	......	wnw.	....
12:28 p. m........	716.9	1.4	67	w.	8.9	4338	444.0	−10.6	......	wnw.	....
1:18 p. m........	716.5	2.6	61	w.	7.2	3935	467.9	− 7.2	......	wnw.	....
1:46 p. m........	716.4	3.0	58	w.	7.2	3850	503.3	− 3.8	......	wnw.	....
1:56 p. m........	716.3	3.2	56	w.	6.7	3944	510.7	− 4.5	......	wnw.	....
2:16 p. m........	716.3	3.8	52	w.	6.3	2596	554.8	− 1.6	......	wnw.	....
2:35 p. m........	716.3	4.2	55	w.	6.7	1955	600.3	2.8	......	w.	....
2:54 p. m........	716.3	5.0	54	wsw.	6.3	1487	640.0	3.1	......	wnw.	....
3:05 p. m........	716.3	4.9	54	w.	8.0	1253	654.7	0.3	......	w.	....
3:13 p. m........	716.3	5.0	56	w.	6.3	895	685.4	1.9	......	w.	....
3:17 p. m........	716.3	5.1	51	wsw.	6.3	526	716.3	5.1	51	wsw.	6.3

January 19.—Six kites were used; lifting surface 37.8 sq. m. Wire out 8000 m.; at maximum altitude, 7500 m.

A few St.-Cu. from the west soon disappeared. A few A.-St. of indeterminate direction were observed at 3:17 p. m.

Pressure was low over the Province of Quebec and high over the Gulf States and Manitoba.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind. Dir.	Wind. Velocity.
1911. January 20:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
9:56 a. m.	720.1	−1.7	87	sse.	7.2	526	720.1	−1.7	87	sse.	7.2
10:06 a. m.	720.0	−1.7	87	sse.	7.6	877	689.0	−0.9	......	sw.	....
10:20 a. m.	719.8	−1.7	87	sse.	7.2	1130	667.3	−0.5	......	wsw.	....
11:16 a. m.	719.1	−0.8	80	se.	8.5	1322	651.0	3.4	......	wsw.	....
11:25 a. m.	719.0	−0.8	82	se.	8.9	1734	619.0	3.1	......	wsw.	....
11:28 a. m.	719.0	−0.8	82	se.	8.5	1306	652.8	3.1	......	wsw.	....
11:30 a. m.	719.0	−0.8	82	se.	8.5	1106	669.1	1.2	......	wsw.	....
11:48 a. m.	718.7	0.2	78	se.	8.5	744	699.6	3.8	......	ssw.	....
2:23 p. m.	716.6	3.2	63	sse.	11.2	526	716.6	3.2	63	sse.	11.2

January 20.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 3500 m.; at maximum altitude, 1700 m.

There were 9/10 St.-Cu. from the west-northwest until 11:30 a. m., and 2/10 at 12:30 p. m.

Pressure was high over the Atlantic States and low from Manitoba to Colorado.

January 21:											
8:09 a. m.	709.4	9.8	70	sw.	9.8	526	709.4	9.8	70	sw.	9.8
8:15 a. m.	709.4	9.8	74	sw.	9.8	850	682.4	10.6	......	sw.	....
8:26 a. m.	709.4	9.8	75	sw.	11.6	1139	659.0	8.6	......	wsw.	....
8:37 a. m.	709.4	9.8	75	sw.	10.7	1836	605.4	4.7	......	wsw.	....
8:49 a. m.	709.4	9.2	77	sw.	10.7	2348	568.5	1.7	......	wsw.	....
9:03 a. m.	709.4	10.3	74	sw.	9.8	2839	534.8	−1.2	......	wsw.	....
9:40 a. m.	709.4	11.0	74	ssw.	10.3	1939	598.2	4.6	......	wsw.	....
10:15 a. m.	709.4	10.8	72	ssw.	9.8	1586	624.5	7.0	......	wsw.	....
10:28 a. m.	709.4	10.9	72	ssw.	9.8	938	675.3	10.9	......	wsw.	....
10:45 a. m.	709.4	10.9	74	ssw.	9.8	808	685.9	10.8	......	sw.	....
10:50 a. m.	709.4	10.8	75	ssw.	10.3	526	709.4	10.8	75	ssw.	10.3

January 21.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5000 m., at maximum altitude.

There were from 5/10 to 10/10 St.-Cu. from the west-southwest. The remainder of the sky was covered with Ci.-St. from the west. Light rain fell from 8:26 to 8:33 a. m. and from 10:50 to 10:57 a. m.

Low pressure was central over Quebec. Pressure was high over the Dakotas and off the South Atlantic coast.

January 23:											
8:11 a. m.	724.5	−6.2	95	nw.	6.7	526	724.5	− 6.2	95	nw.	6.7
8:26 a. m.	724.7	−6.0	100	nw.	7.2	886	692.2	− 3.9	......	nnw.	....
8:37 a. m.	724.8	−5.7	100	nw.	6.7	1288	657.9	− 5.2	......	nnw.	....
9:03 a. m.	725.0	−5.3	98	nw.	6.3	1839	613.4	− 7.7	......	nnw.	....
9:22 a. m.	725.1	−4.7	95	nw.	8.0	2012	600.1	− 8.7	......	nnw.	....
9:46 a. m.	725.2	−4.3	88	nw.	8.0	2494	563.7	−12.0	......	nnw.	....
10:19 a. m.	725.5	−4.6	93	nw.	8.9	3252	510.4	−16.7	......	nnw.	....
10:22 a. m.	725.6	−4.6	94	nw.	8.9	3549	490.8	−15.9	......	nnw.	....
10:30 a. m.	725.6	−4.6	94	nw.	8.0	3971	463.9	−16.7	......	wnw.	....
10:42 a. m.	725.8	−4.6	95	nw.	7.2	3770	476.5	−16.1	......	wnw.	....
10:58 a. m.	726.0	−4.4	96	nw.	8.9	3392	501.2	−17.7	......	wnw.	....
11:20 a. m.	726.1	−4.2	98	nw.	8.9	2414	570.9	−12.2	......	nw.	....
11:35 a. m.	726.2	−4.2	96	wnw	8.0	1417	648.6	− 5.5	......	nw.	....
11:42 a. m.	726.3	−4.1	98	nw.	9.8	1029	681.5	− 2.6	......	nw.	....
11:53 a. m.	726.4	−4.0	100	nw.	8.0	886	694.0	− 3.7	......	nw.	....
12:01 p. m.	726.4	−4.0	98	wnw.	8.0	526	726.4	− 4.0	98	wnw.	8.0

January 23.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 7500 m.; at maximum altitude, 6500 m.

There were a few to 5/10 low St. from the northwest until 11 a. m. At the close there were a few Cu. from the northwest. Fog in the Shenandoah Valley until 11 a. m.

An area of high pressure was central over the Middle Mississippi Valley. Another high area was central over Maine.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
January 24:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
11:19 a. m......	730.7	0.8	54	se.	5.8	526	730.7	0.8	54	se.	5.8
11:25 a. m......	730.6	1.0	54	se.	5.8	854	701.4	1.0	......	ssw.	....
12:02 p. m.....	730.3	1.2	52	s.	5.8	1120	678.3	−0.4	......	ssw.	....
12:16 p. m.....	730.2	1.3	52	s.	6.3	1227	669.2	1.6	......	sw.	....
12:39 p. m.....	730.1	1.6	51	s.	7.2	1446	651.1	0.7	......	sw.	....
1:14 p. m.....	729.8	1.4	60	sse.	5.4	1895	615.5	−0.8	......	wsw.	....
1:22 p. m.....	729.7	1.2	52	sse.	3.6	1443	651.1	1.6	......	wsw.	....
1:33 p. m.....	729.4	1.6	54	s.	4.5	1157	674.5	2.1	......	sw.	....
1:44 p. m.....	729.3	1.8	56	s.	4.0	902	696.1	1.2	......	ssw.	....
1:49 p. m.....	729.3	2.5	55	s.	4.0	526	729.3	2.5	55	s.	4.0

January 24.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 2800 m.; at maximum altitude, 2000 m.

There were 1/10 to 3/10 Ci.-St. from the west.

At 8 a. m. an extensive high, central over Virginia, covered the country east of the Mississippi.

January 25:											
4:54 p. m.....	724.7	5.6	44	se.	3.6	526	724.9	5.6	44	se.	3.6
5:02 p. m.....	724.7	4.4	47	se.	3.1	1799	619.9	5.4	......	sw.	....
5:20 p. m.....	724.7	3.6	47	se.	3.6	1142	671.7	3.5	......	sw.	....
5:25 p. m.....	724.7	3.6	47	se.	3.6	1014	682.5	3.2	......	sw.	....
5:30 p. m.....	724.7	3.6	47	se.	3.6	742	705.7	4.0	......	ssw.	....
5:38 p. m.....	724.7	3.4	47	se.	3.6	526	724.7	3.4	47	se.	3.6

January 25.—One balloon was used; capacity, 22.4 cu. m. Wire out, 2400 m.

There were 3/10 A.-Cu. from the west-southwest.

Pressure was high over the Virginia coast and low over British Columbia.

January 26:											
10:39 a. m......	721.0	4.0	100	w.	6.3	526	721.0	4.0	100	w.	6.3
10:40 a. m......	721.0	4.0	99	w.	5.4	693	706.4	7.6	......	wnw.	....
10:53 a. m......	720.9	3.8	97	w.	6.3	901	688.8	8.0	......	w.	....
10:56 a. m......	720.9	3.8	97	w.	6.3	1256	659.7	6.7	......	w.	....
11:00 a. m......	720.9	3.8	97	w.	6.3	1540	637.4	7.2	......	w.	....
11:15 a. m......	720.8	4.0	97	w.	5.4	2158	590.9	3.4	......	wnw.	....
11:34 a. m......	720.6	4.0	97	w.	6.7	2617	558.2	1.3	......	wnw.	....
11:57 a. m......	720.3	4.8	92	w.	5.4	2844	542.6	0.8	......	wnw.	....
12:49 p. m.....	719.9	5.2	89	w.	6.7	3389	506.7	−1.9	......	w.	....
1:16 p. m.....	719.7	5.1	88	w.	5.4	2786	546.3	2.0	......	wnw.	....
1:38 p. m.....	719.5	5.3	89	w.	6.3	2532	563.6	3.2	......	wnw.	....
1:52 p. m.....	719.5	5.1	88	w.	5.4	2120	592.8	6.0	......	wnw.	....
2:08 p. m.....	719.4	6.4	88	wsw.	6.3	1697	624.2	8.4	......	wnw.	....
2:13 p. m.....	719.4	6.9	88	wsw.	6.3	1523	637.4	5.9	......	wnw.	....
2:22 p. m.....	719.4	7.5	85	w.	5.4	1359	650.4	6.2	......	wnw.	....
2:42 p. m.....	719.3	8.6	81	wsw.	5.4	718	702.9	10.2	......	w.	....
2:46 p. m.....	719.3	8.9	79	wsw.	5.4	526	719.3	8.9	79	wsw.	5.4

January 26.—Five kites were used; lifting surface 31.5 sq. m. Wire out 7000 m.; at maximum altitude, 6800 m.

There were 9/10 to 4/10 St.-Cu. from the west-northwest; altitude of base about 2100 m. A few St., altitude 600 m., and fog in the Shenandoah were dissipated during the flight.

Pressure was high east of the Mississippi and low over western Iowa and eastern Nebraska.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. January 27:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:19 a. m......	718.0	10.4	84	wsw.	6.7	526	718.0	10.4	84	wsw.	6.7
8:37 a. m......	718.0	11.8	75	wsw.	8.0	808	694.4	11.3	......	wsw.	....
8:59 a. m......	717.9	13.0	72	sw.	7.6	1630	628.8	5.1	......	w.	....
9:07 a. m......	717.9	13.1	72	wsw.	7.6	1827	613.8	4.0	......	wnw.	....
9:12 a. m......	717.9	13.1	71	wsw.	7.2	2029	598.6	8.2	......	wnw.	....
9:29 a. m......	717.8	13.5	71	wsw.	6.7	2522	564.0	6.2	......	wnw.	....
9:54 a. m......	717.7	14.0	68	wsw.	6.7	3215	518.1	2.0	......	w.	....
11:00 a. m......	717.4	15.0	64	w.	8.5	4246	455.4	—4.3	......	w.	....
12:07 p. m......	716.8	15.4	65	wsw.	7.2	4804	423.1	—9.7	......	w.	....
1:12 p. m......	716.1	15.6	65	wsw.	7.6	4030	466.1	—4.7	......	w.	....
1:41 p. m......	716.0	15.8	66	wsw.	6.7	2999	530.2	2.8	......	w.	....
2:00 p. m......	715.9	15.9	65	wsw.	6.3	2341	575.0	4.2	......	w.	....
2:10 p. m......	715.9	16.0	64	wsw.	4.5	1960	602.3	6.6	......	wsw.	....
2:13 p. m......	715.8	16.1	64	wsw.	4.9	1781	615.6	5.8	......	wsw.	....
2:19 p. m......	715.8	16.0	63	wsw.	6.7	1536	634.2	5.7	......	wsw.	....
2:35 p. m......	715.7	15.5	66	wsw.	8.5	845	689.2	11.6	......	wsw.	....
2:43 p. m......	715.7	15.5	67	sw.	7.2	526	715.7	15.5	67	sw.	7.2

January 27.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 11000 m.; at maximum altitude, 9750 m.

Ci.-St. and St.-Cu., from the west-northwest, covered the sky. Solar halo, 12:20 to 1:20 p. m. The head kite was hidden by St.-Cu. at intervals from 9:04 a. m. to 2:19 p. m.; altitude of St.-Cu. base about 1600 m.

High pressure was central over the South Atlantic States. Pressure was relatively low over Lake Michigan.

January 28:											
1:37 p. m......	721.9	7.0	38	wnw.	12.5	526	721.9	7.0	38	wnw.	12.5
1:48 p. m......	721.9	7.0	36	wnw.	12.1	925	687.5	2.7	......	wnw.	....
2:00 p. m......	721.9	6.8	34	wnw.	13.4	1548	636.1	—2.6	......	nw.	....
2:16 p. m......	722.0	7.2	29	wnw.	12.5	1969	603.0	—5.5	......	nw.	....
3:19 p. m......	722.0	7.4	25	wnw.	9.8	526	722.0	7.4	25	wnw.	9.8

January 28.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4500 m.; at maximum altitude, 3400 m.

The sky was cloudless. Light haze.

At 8 a. m. high pressure was central over Illinois and low pressure off the New England coast.

January 29:											
8:34 a. m......	720.6	2.1	39	sse.	10.7	526	720.6	2.1	39	sse.	10.7
8:42 a. m......	720.5	2.3	40	sse.	10.7	871	690.5	3.6	......	ssw.	....
8:57 a. m......	720.4	2.7	52	sse.	11.6	1447	643.1	3.1	......	sw.	....
9:28 a. m......	719.7	2.6	40	s.	10.7	1999	599.9	—0.5	......	ssw.	....
9:38 a. m......	719.5	2.6	40	sse.	10.7	2240	581.7	—1.7	......	sw.	....
9:47 a. m......	719.3	2.6	42	sse.	10.7	2110	590.8	—1.1	......	sw.	....
10:18 a. m......	718.7	2.4	51	sse.	10.7	1712	620.5	—0.9	......	ssw.	....
10:40 a. m......	718.4	2.6	53	s.	10.3	934	683.2	3.3	......	ssw.	....
10:49 a. m......	718.2	2.6	53	s.	10.7	526	718.2	2.6	53	s.	10.7

January 29.—Three kites were used; lifting surface, 14.5 sq. m. Wire out, 5000 m.; at maximum altitude, 4700 m.

At first there were 9/10 St. from the southwest and 1/10 St.-Cu. from the south; later 10/10 N. from the southwest. Snow fell after 10 a. m.

The pressure was high over the Atlantic and Gulf coasts and low over the upper Lake region.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
January 30:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:10 a. m.	702.3	4.8	64	wnw.	19.7	526	702.3	4.8	64	wnw.	19.7
8:16 a. m.	702.4	4.8	64	wnw.	17.0	926	668.6	2.1	......	wnw.	....
8:26 a. m.	702.5	4.4	70	wnw.	17.0	1421	628.6	−2.6	......	wnw.	....
8:42 a. m.	702.6	4.2	65	wnw.	17.0	1610	613.8	−4.3	......	wnw.	....
8:51 a. m.	702.7	4.0	60	wnw.	17.0	2437	552.7	−5.7	......	wnw.	....
9:11 a. m.	702.9	4.4	......	wnw.	15.2	1125	652.5	−1.1	......	wnw.	....
11:48 a. m.	703.8	3.3	......	wnw.	16.1	1132	652.5	−2.7	......	wnw.	....
2:27 p. m.	704.3	3.3	......	wnw.	17.0	1136	652.5	−3.6	......	wnw.	....
3:00 p. m.	705.8	3.2	......	wnw.	26.8	526	705.8	3.2	......	wnw.	26.8

January 30.—Three kites were used; lifting surface, 16.2 sq. m. Wire out, 3500 m.; at maximum altitude, 3300 m.

There were 4/10 to 6/10 St.-Cu. from the west-northwest.

A storm of great intensity was central over the lower St. Lawrence Valley. Pressure was high over the upper Mississippi Valley.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.
January 31:											
1:32 p. m.	715.6	−3.0	66	s.	4.5	526	715.6	−3.0	66	s.	4.5
1:54 p. m.	715.4	−2.8	66	s.	4.5	911	681.2	−5.7	......	sw.	....
2:20 p. m.	715.3	−2.5	62	s.	4.5	1185	657.7	−7.7	......	wsw.	....
2:29 p. m.	715.3	−2.5	62	s.	4.0	1472	634.1	−5.5	......	w.	....
2:50 p. m.	715.2	−2.2	63	s.	3.6	2152	581.7	−3.3	......	w.	....
3:09 p. m.	715.1	−3.3	65	s.	3.6	2582	550.8	−4.3	......	w.	....
3:37 p. m.	714.9	−2.4	67	s.	4.0	3426	494.4	−8.2	......	wnw.	....
4:07 p. m.	714.8	−2.6	67	s.	2.7	2866	531.5	−5.6	......	wnw.	....
4:24 p. m.	714.8	−3.0	74	s.	3.6	2532	554.4	−4.3	......	wnw.	....
4:42 p. m.	714.8	−3.5	85	s.	3.1	2005	592.6	−2.6	......	wnw.	....
4:58 p. m.	714.8	−4.0	96	s.	2.7	1358	643.0	−4.3	......	w.	....
5:03 p. m.	714.8	−4.1	96	s.	2.7	965	676.0	−6.4	......	wsw.	....
5:06 p. m.	714.8	−4.1	96	s.	2.2	526	714.8	−4.1	96	s.	2.2

January 31.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 6000 m.; at maximum altitude, 5800 m.

There were 10/10 A.-St. from the west. These were hidden by St. from the west-northwest after 4 p. m. Light snow fell after 3:50 p. m. The head kite entered the clouds at 3:02 p. m. at an altitude of 2500 m. and emerged at 4:39 p. m. at an altitude of 2000 m.

Pressure was high over the Middle and South Atlantic Coast States and low over Nova Scotia.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.
February 1:											
1:00 p. m.	717.3	− 1.6	100	se.	10.3	526	717.3	− 1.6	100	se.	10.3
1:10 p. m.	717.3	− 1.6	100	se.	8.5	755	697.1	0.4	......	se.	....
1:28 p. m.	717.2	− 1.6	100	se.	8.5	878	686.5	3.1	......	sse.	....
2:21 p. m.	717.1	− 1.4	100	se.	7.2	1266	653.9	1.2	......	s.	....
2:36 p. m.	717.1	− 1.4	100	se.	7.2	1000	675.8	2.5	......	sse.	....
2:43 p. m.	717.1	− 1.4	100	se.	7.2	855	688.2	− 0.4	......	se.	....
2:51 p. m.	717.1	− 1.2	100	se.	8.5	526	717.1	− 1.2	100	se.	8.5

February 1.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 3000 m.; at maximum altitude, 2400 m.

There was dense fog.

At 8 a. m. an extensive low was central over the Great Plains and high pressure prevailed over the St. Lawrence Valley.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. February 2: First flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
10:49 a. m....	708.6	7.4	92	wsw.	5.4	526	708.6	7.4	92	wsw.	5.4
10:54 a. m....	708.6	8.0	94	wsw.	4.9	895	677.9	12.1	......	w.	....
11:07 a. m....	708.6	8.3	95	wsw.	5.4	1404	637.8	8.8	......	w.	....
11:13 a. m....	708.6	8.7	91	w.	5.4	1632	620.5	7.0	......	wnw.	....
11:27 a. m....	708.6	9.5	89	wsw.	6.7	2087	587.2	5.6	......	wnw.	....
11:44 a. m....	708.5	10.3	87	w.	5.4	2137	583.6	7.0	......	wnw.	....
11:57 a. m....	708.5	11.0	83	w.	6.7	1824	606.1	6.3	......	wnw.	....
12:45 p. m....	708.3	13.2	69	w.	4.9	1554	626.5	8.6	......	w.	....
1:08 p. m....	708.1	13.4	69	wnw.	7.2	872	679.6	13.2	......	w.	....
1:12 p. m....	708.1	13.2	69	wnw.	7.2	526	708.1	13.2	69	wnw	7.2
Second flight—											
2:44 p. m....	708.7	13.6	65	nw.	6.3	526	708.7	13.6	65	nw.	6.3
2:59 p. m....	708.9	13.8	61	nw.	6.3	942	674.7	10.9	......	nw.	....
3:17 p. m....	709.1	14.3	60	wnw.	10.7	1552	627.0	6.3	......	w.	....
3:29 p. m....	709.3	14.6	47	wnw.	14.8	1922	599.4	2.3	......	w.	....
3:47 p. m....	709.6	13.4	48	wnw.	15.2	2625	549.6	3.0	......	wnw.	....
3:53 p. m....	709.6	13.0	46	wnw.	14.3	3024	523.1	0.7	......	wnw.	....
4:55 p. m....	710.4	8.8	58	wnw.	15.2	526	710.4	8.8	58	wnw.	15.2

February 2.—First flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5000 m.; at maximum altitude.

There were 2/10 to 4/10 Ci.-St. from the west-southwest and 1/10 to 3/10 A.-St. from the same direction. Solar halo, 10:50 a. m.

Second flight: Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5500 m.; at maximum altitude, 5300 m.

There were 2/10 A.-St. from the west-southwest before 3 p. m. The sky was cloudless thereafter.

A low pressure area was central over western New York. Pressure was high over New Brunswick and comparatively high over the Gulf of Mexico.

February 3:											
8:58 a. m......	719.0	− 5.2	81	e.	6.3	526	719.0	− 5.2	81	e.	6.3
9:13 a. m......	719.0	− 4.8	81	e.	7.6	710	702.3	− 7.2	......	ese.	....
10:04 a. m......	719.0	− 4.4	76	e.	7.6	1789	613.6	5.0	......	sse.	....
10:26 a. m......	719.0	− 3.7	75	ese.	7.6	2760	544.4	0.6	......	ssw.	....
10:52 a. m......	718.9	− 2.8	73	ese.	8.9	3171	517.2	− 1.6	......	sw.	....
11:20 a. m......	718.7	− 2.6	70	ese.	8.0	4043	462.8	− 7.0	......	sw.	....
11:47 a. m......	718.4	− 1.8	67	ese.	8.5	4778	420.9	−13.5	......	sw.	....
12:35 p. m......	717.8	− 1.2	65	ese.	9.4	4044	462.8	− 8.0	......	sw.	....
1:05 p. m......	717.6	− 1.0	65	ese.	10.3	3307	508.1	− 3.3	......	sw.	....
1:32 p. m......	717.3	− 0.4	64	se.	13.0	2694	548.5	1.5	......	sw.	....
1:48 p. m......	717.1	− 0.6	61	ese.	13.9	2171	584.8	5.0	......	sw.	....
2:10 p. m......	716.9	− 0.3	59	ese.	14.3	1717	618.1	5.5	......	s.	....
2:24 p. m......	716.8	− 0.6	60	ese.	13.4	1395	642.5	5.0	......	s.	....
2:30 p. m......	716.8	− 0.8	59	se.	13.4	1028	672.7	− 6.5	......	se.	....
2:46 p. m......	716.7	− 0.7	56	se.	13.4	526	716.7	− 0.7	56	se.	13.4

February 3.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 8000 m.; at maximum altitude, 7600 m.

There were 1/10 to 6/10 Ci.-St. from the southwest. There were a few St. from the east-southeast between 11:06 and 11:22 a. m. Solar halo.

Pressure was high over Vermont and low over Lake Superior and over Kansas.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
February 4:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
10:09 a. m......	707.3	3.2	97	w.	8.9	526	707.3	3.2	97	w.	8.9
10:12 a. m......	707.3	3.4	97	w.	8.9	868	678.2	5.5	......	wnw.	....
10:27 a. m......	707.4	4.0	92	w.	10.7	1470	630.0	2.4	......	wnw.	....
10:30 a. m......	707.4	4.0	91	w.	9.8	1823	603.1	4.2	......	wnw.	....
10:54 a. m......	707.6	5.6	90	w.	10.7	2453	558.1	0.0	......	wnw.	....
10:58 a. m......	707.6	5.7	90	w.	10.7	2540	552.1	0.4	......	wnw.	....
11:16 a. m......	707.7	6.0	88	wnw.	8.5	3102	514.8	− 2.8	......	w.	....
11:36 a. m......	707.8	6.9	85	wnw.	8.0	3875	466.6	− 6.4	......	w.	....
12:02 p. m......	707.9	7.2	85	wnw.	7.6	3549	486.2	− 5.4	......	w.	....
12:19 p. m......	708.0	7.7	85	wnw.	7.2	3191	508.7	− 3.4	......	wnw.	....
12:27 p. m......	708.0	8.2	84	wnw.	8.9	2836	531.9	0.1	......	wnw.	....
12:33 p. m......	708.0	8.4	83	wnw.	8.0	2747	537.9	− 1.2	......	wnw.	....
12:46 p. m......	708.1	8.8	80	wnw.	14.3	2280	570.2	1.1	......	wnw.	....
1:22 p. m......	708.2	10.4	59	wnw.	17.9	1589	621.6	0.1	......	wnw.	....
1:32 p. m......	708.4	10.2	56	wnw.	17.0	1382	638.0	1.7	......	wnw.	....
1:43 p. m......	708.5	10.0	57	wnw.	10.3	934	674.3	5.0	......	wnw.	....
1:54 p. m......	708.6	9.8	66	wnw.	9.8	526	708.6	9.8	66	wnw.	9.8

February 4.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 7000 m. at maximum altitude.

A.-St. from the west diminished from 5/10 to none by 1 p. m. There were 3/10 to 5/10 St.-Cu. from the west-northwest at an altitude of 1500 m.

At 8 a. m. pressure was low over the lower Lake region and high over the Gulf of St. Lawrence and over the Dakotas and Minnesota.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
February 5:											
8:21 a. m......	718.9	− 2.0	67	nw.	13.4	526	718.9	− 2.0	67	nw.	13.4
8:30 a. m......	719.0	− 1.9	66	wnw.	13.4	938	682.5	− 5.2	......	nw.	....
8:54 a. m......	719.2	− 2.0	65	nw.	10.3	1617	625.8	− 9.2	......	nw.	....
9:08 a. m......	719.3	− 2.0	67	nw.	13.9	2030	593.8	− 1.2	......	nw.	....
9:23 a. m......	719.5	− 2.0	67	nw.	9.4	2950	529.0	− 3.7	......	nw.	....
10:43 a. m......	720.2	− 2.5	62	nw.	13.4	3531	491.8	− 5.9	......	wnw.	....
11:20 a. m......	720.3	− 2.3	60	nw.	8.9	4413	439.2	−12.1	......	wnw.	....
12:07 p. m......	720.3	− 2.6	68	nw.	6.7	3147	517.0	− 4.2	......	wnw.	....
12:29 p. m......	720.2	− 2.6	66	nnw.	7.6	2341	572.0	− 0.5	......	nw.	....
12:50 p. m......	720.1	− 2.4	62	nnw.	8.5	1487	637.1	− 5.2	......	nnw.	....
12:55 p. m......	720.1	− 2.5	64	nw.	6.3	1093	669.9	− 7.0	......	nnw.	....
1:00 p. m......	720.1	− 2.6	64	nw.	6.3	906	686.2	− 6.6	......	nnw.	....
1:06 p. m......	720.1	− 2.4	67	nnw.	7.6	526	720.1	− 2.4	67	nnw.	7.6

February 5.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 8000 m.; at maximum altitude, 7400 m.

Ci.-St. and A.-St. from the west-northwest and St.-Cu. from the northwest, increased from 2/10 at the beginning to 8/10 at the end of the flight.

High pressure was central north of Lake Superior, low pressure over the Gulf of St. Lawrence.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
February 6:											
10:35 a. m......	718.8	− 8.6	100	sse.	14.3	526	718.8	− 8.6	100	sse.	14.3
10:44 a. m......	718.8	− 8.6	100	se.	13.4	827	691.4	− 9.3	......	sse.	....
10:57 a. m......	718.8	− 8.5	100	se.	13.0	1265	653.6	− 4.5	......	sse.	....
11:08 a. m......	718.8	− 8.4	100	se.	12.5	1671	621.0	− 2.0	......	s.	....
11:32 a. m......	718.6	− 8.4	100	se.	9.8	2189	581.7	− 4.4	......	s.	....
11:40 a. m......	718.6	− 8.4	100	se.	10.7	526	718.6	− 8.4	100	se.	10.7

February 6.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 4000 m., at maximum altitude.

There were dense fog and driving snow.

Low pressure was central over Indiana, high pressure over Ontario.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
February 7:	*mm.*	*° C.*	%		*m. p. s.*	*m.*	*mm.*	*° C.*	%		*m. p. s.*
2:17 p. m.....	718.0	— 0.4	100	nw.	5.4	526	718.0	— 0.4	100	nw.	5.4
2:24 p. m.....	718.0	— 0.1	100	nw.	5.4	840	690.4	— 0.7	......	nw.	....
2:33 p. m.....	718.0	0.5	100	nw.	5.4	1268	654.3	— 1.6	......	wnw.	....
2:40 p. m.....	718.0	0.3	98	wnw.	4.0	1386	644.9	5.1	......	wnw.	....
2:53 p. m.....	718.0	0.4	97	nw.	3.6	1974	600.0	4.3	......	wnw.	....
3:03 p. m.....	718.0	0.7	92	nw.	3.6	2351	572.7	2.8	......	wnw.	....
3:36 p. m.....	718.1	1.8	76	nnw.	3.1	1843	609.7	3.7	......	wnw.	....
3:56 p. m.....	718.2	1.9	74	nnw.	3.1	1508	635.5	3.2	......	wnw.	....
4:05 p. m.....	718.3	1.9	74	nnw.	2.7	908	684.9	— 1.9	......	wnw.	....
4:14 p. m.....	718.5	1.6	78	nw.	4.0	526	718.5	1.6	78	nw.	4.0

February 7.—Three kites were used; lifting surface, 20.9 sq. m. Wire out, 3400 m.; at maximum altitude, 3000 m.

There were 4/10 to few Ci.-St. from the west-southwest; 2/10 St. from the west-northwest at 2 p. m. soon disappeared.

Areas of low pressure were central over North Dakota and over northern Texas. Pressure was high over New Brunswick and comparatively low over the lower Lake region and the Middle Atlantic coast.

February 9:											
4:54 p. m.....	712.1	— 2.4	100	n.	0.9	526	712.1	— 2.4	100	n.	0.9
5:02 p. m.....	712.1	— 2.2	100	n.	0.9	867	682.3	— 1.0	......	wnw.	....
5:10 p. m.....	712.1	— 2.2	100	n.	0.9	661	700.1	— 2.4	......	wnw.	....
5:15 p. m.....	712.1	— 2.2	100	n.	0.9	526	712.1	— 2.2	100	n.	0.9

February 9.—One balloon was used; capacity, 14.1 cu. m. Wire out, 1300 m.

There were 10/10 St. from the west-northwest, light fog and light snow.

At 8 a. m. pressure was low over Georgia and Lake Superior and high over Nebraska.

February 10:											
8:31 a. m......	714.0	— 4.6	86	wnw.	11.6	526	714.0	— 4.6	86	wnw.	11.6
8:39 a. m......	714.1	— 4.0	80	wnw.	13.4	952	676.3	— 7.1	......	wnw.	....
8:49 a. m......	714.2	— 3.6	77	wnw.	14.8	1382	639.8	—11.6	......	wnw.	....
9:05 a. m......	714.3	— 3.4	74	wnw.	13.4	1727	611.8	—13.1	......	wnw.	....
9:16 a. m......	714.4	— 3.2	72	wnw.	12.5	2106	582.1	—15.0	......	wnw.	....
9:30 a. m......	714.4	— 3.2	69	wnw.	17.9	2175	576.7	—14.2	......	wnw.	....
9:47 a. m......	714.5	— 3.6	68	wnw.	17.9	2347	563.9	—15.6	......	wnw.	....
10:06 a. m......	714.6	— 3.6	68	wnw.	16.1	2062	585.8	—13.1	......	wnw.	....
10:14 a. m......	714.6	— 3.6	68	wnw.	19.7	1797	606.4	—14.1	......	wnw.	....
10:28 a.m......	714.7	— 3.6	68	wnw.	20.6	1495	630.9	—11.9	......	wnw.	....
11:14 a. m......	714.9	— 3.6	68	wnw.	20.6	943	678.0	— 7.1	......	wnw.	....
11:24 a. m......	715.0	— 3.6	68	wnw.	24.1	526	715.0	— 3.6	68	wnw.	24.1

February 10.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5000 m.; at maximum altitude, 4700 m.

There were a few to 6/10 St.-Cu. from the west-northwest, at an altitude of 2100 m. at 9:16 and 1500 m. at 10:10 a. m.

Pressure was low off the New England coast and high over Illinois.

February 11:											
8:07 a. m......	724.0	— 5.0	66	w.	4.0	526	724.0	— 5.0	66	w.	4.0
8:27 a. m......	724.3	— 4.4	59	w.	4.0	956	685.8	— 5.1	......	wnw.	....
8:43 a. m......	724.5	— 4.3	62	w.	5.4	1546	636.7	— 0.5	......	nw.	....
9:05 a. m......	724.7	— 3.9	61	w.	4.5	2160	589.8	— 3.3	......	nw.	....
9:52 a. m......	724.4	— 2.4	50	wsw.	4.0	2528	562.5	— 5.2	......	nw.	....
10:13 a. m......	724.3	— 1.6	48	s.	3.6	1460	643.8	— 0.1	......	wnw.	....
10:29 a. m......	724.3	— 1.1	45	ssw.	4.0	858	694.6	— 4.4	......	wsw.	....
10:35 a. m......	724.4	— 1.2	41	ssw.	4.5	526	724.4	— 1.2	41	ssw.	4.5

February 11.—Four kites were used; lifting surface, 27.2 sq. m. Wire out 3500 m.; at maximum altitude, 2500 m.

There were 4/10 to 9/10 A.-St. from the west-northwest, also 4/10 to 2/10 Ci.-St. from the west-northwest before 8:30 a. m.

Pressure was high over North Carolina and Virginia and low over the northern and central plains States.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
				Wind.						Wind.	
	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
1911. February 12:	mm.	° C.	%		m. p. s.	m.	mm.	° C.	%		m. p. s
6:50 a. m.	718.6	0.3	98	wnw.	7.2	526	718.6	0.3	98	wnw.	7.2
6:56 a. m.	718.5	0.2	97	wnw.	8.0	724	701.0	1.4	......	nw.	....
7:07 a. m.	718.5	0.0	88	wnw.	8.5	994	677.9	0.1	......	wnw.	....
7:17 a. m.	718.5	−0.2	84	wnw.	6.7	1080	670.6	1.8	......	wnw.	....
8:20 a. m.	718.6	1.1	64	wnw.	8.0	1798	613.4	−2.7	......	wnw.	....
9:01 a. m.	718.6	2.2	61	wnw.	6.3	2794	540.9	−6.1	......	nw.	....
9:11 a. m.	718.6	2.2	61	wnw.	6.3	2739	544.6	−6.5	......	nw.	....
9:31 a. m.	718.5	2.7	61	nw.	....	1673	623.0	0.2	......	nw.	....
9:45 a. m.	718.4	2.3	67	wnw.	8.0	1320	650.8	1.9	......	nw.	....
9:57 a. m.	718.4	2.6	62	nw.	5.4	887	686.9	0.0	......	wnw.	....
10:07 a. m.	718.4	2.6	62	nnw.	9.8	526	718.4	2.6	62	nnw.	9.8

February 12.—Six kites were used; lifting surface, 38.8 sq. m. Wire out, 5500 m.; at maximum altitude, 4000 m.

5/10 to few St.-Cu. from the west-northwest prevailed. There was 1/10 St. from the west-northwest before 8:40 a. m.

An area of high pressure was central over the Tennessee Valley. Pressure was low over the northern Rocky Mountains and comparatively low off the North Carolina coast.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
February 13:											
8:24 a. m.	717.5	1.1	86	sse.	10.7	526	717.5	1.1	86	sse.	10.7
8:30 a. m.	717.5	1.5	86	s.	9.8	832	690.8	−0.2	......	ssw.	....
8:39 a. m.	717.5	1.6	84	sse.	8.9	1044	672.8	4.6	......	ssw.	....
8:43 a. m.	717.5	1.8	84	sse.	8.9	1175	662.2	3.3	......	sw.	....
8:46 a. m.	717.5	2.0	83	se.	8.9	1407	643.6	4.9	......	sw.	....
9:06 a. m.	717.4	2.8	81	se.	9.8	2196	584.1	1.9	......	w.	....
9:25 a. m.	717.2	2.7	82	se.	8.9	2606	555.0	3.4	......	wnw.	....
9:38 a. m.	717.1	2.8	81	se.	10.3	2919	533.9	2.5	......	wnw.	....
10:00 a. m.	716.9	3.0	81	se.	9.8	3680	485.6	−2.4	......	wnw.	....
10:28 a. m.	716.8	3.6	76	se.	8.5	4356	446.1	−5.5	......	wnw.	....
11:33 a. m.	716.4	5.2	75	sse.	4.9	3434	501.6	−1.3	......	wnw.	....
12:10 p. m.	716.1	6.4	69	s.	4.0	2405	569.5	5.6	......	wnw.	....
12:30 p. m.	715.8	7.1	71	se.	3.1	1658	623.4	8.1	......	wnw.	....
12:34 p. m.	715.7	6.9	72	ese.	3.1	1540	632.4	6.6	......	wnw.	....
12:43 p. m.	715.6	6.8	72	ese.	3.6	690	701.5	3.7	......	wsw.	....
12:47 p. m.	715.6	7.2	74	se.	3.6	526	715.6	7.2	74	se.	3.6

February 13.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7500 m., at maximum altitude.

There were 6/10 to 1/10 St. and St.-Cu. from the south until 9:45 a. m., and 1/10 to 8/10 Ci.-St. from the northwest thereafter. A halo was seen at 12:17 p. m. St. passed under the head kite at 8:34 a. m.; altitude about 900 m.

Pressure was low over western Kansas, and was high over the south Atlantic coast and the St. Lawrence Valley.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
February 14:											
8:10 a. m.	714.7	1.9	83	e.	8.9	526	714.7	1.9	83	e.	8.9
11:00 a. m.	714.0	3.9	80	ese.	8.9	750	694.6	2.6	......	sse.	....
11:15 a. m.	713.8	4.2	79	se.	10.3	1071	667.7	8.4	......	s.	....
11:24 a. m.	713.7	4.3	80	se.	8.9	1184	658.5	7.0	......	ssw.	....
11:26 a. m.	713.7	4.3	80	se.	8.9	1347	645.6	7.4	......	ssw.	....
11:30 a. m.	713.6	4.2	79	se.	10.3	1514	632.6	6.4	......	sw.	....
11:32 a. m.	713.6	4.2	79	se.	11.2	1664	621.2	7.0	......	sw.	....
11:39 a. m.	713.5	4.4	77	se.	11.6	2162	584.3	3.3	......	wsw.	....
11:49 a. m.	713.4	4.5	76	se.	10.3	2520	558.8	0.3	......	wsw.	....
11:59 a. m.	713.3	4.5	76	se.	11.6	2800	539.6	−1.0	......	wsw.	....
1:26 p. m.	712.0	3.4	97	ese.	10.3	526	712.0	3.4	97	ese.	10.3

February 14.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5000 m.; at maximum altitude, 4000 m.

St.-Cu. from the west diminished from 10/10 to few by 9 a. m. Above them were 5/10 Ci.-St. and A.-St. from the west-northwest with solar halo. After 11 a. m. the sky was overcast with St.-Cu. from the west-southwest, their altitude diminishing from 2500 m. to 1500 m. Rain began at 12:05 p. m. and fog set in about 3 p. m.

At 8 a. m. pressure was high over Florida and the St. Lawrence Valley and a well-developed low was central over northern Illinois.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. February 15:	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
1:50 p. m.....	721.8	−3.8	100	e.	8.0	526	721.8	−3.8	100	e.	8.0
1:55 p. m.....	721.8	−3.8	100	e.	7.2	555	719.2	−5.6	......	ese.	....
2:09 p. m.....	721.8	−3.9	98	e.	7.2	927	686.0	−2.7	......	ese.	....
2:17 p. m.....	722.0	−4.2	100	e.	8.0	709	705.4	−5.6	......	ese.	....
2:20 p. m.....	722.0	−4.2	100	e.	6.7	526	721.9	−4.2	100	e.	6.7

February 15.—Two kites were used; lifting surface, 12.6 sq. m. Wire out, 1000 m., at maximum altitude.

There was dense fog.

Pressure was high over the St. Lawrence Valley and low over Kansas and Colorado and off the south Atlantic coast.

February 16:											
1:38 p. m.....	727.2	−2.7	100	se.	6.3	526	727.2	−2.7	100	se.	6.3
1:45 p. m.....	727.2	−2.7	100	se.	6.3	581	722.1	−3.5	......	s.	....
2:17 p. m.....	727.2	−2.5	100	sse.	4.9	833	699.5	−2.5	......	s.	....
2:23 p. m.....	727.2	−2.5	100	sse.	5.4	602	720.4	−3.5	......	s.	....
2:25 p. m.....	727.2	−2.5	100	sse.	5.4	526	727.2	−2.5	100	sse.	5.4

February 16.—Two kites were used; lifting surface, 14.6 sq. m. Wire out, 800 m.; at maximum altitude, 450 m.

There was dense fog.

Pressure was high over Vermont and low over Texas.

February 17:											
2:19 p. m.....	718.5	10.4	86	wsw.	6.3	526	718.5	10.4	86	wsw.	6.3
2:21 p. m.....	718.5	10.4	86	wsw.	6.3	694	704.3	14.1	......	wsw.	....
2:28 p. m.....	718.5	10 6	85	sw.	6.3	971	681.3	12.8	......	w.	....
2:38 p. m.....	718.5	10.7	87	wsw.	4.5	1629	630.0	9.5	......	wnw.	....
2:45 p. m.....	718.4	10.4	86	w.	4.5	2108	594.4	6.5	......	wnw.	....
2:50 p. m.....	718.4	10.5	86	w.	4.5	2288	581.7	8.4	......	wnw.	....
3:30 p. m.....	718.4	10.2	84	w.	4.9	2837	544.3	6.4	......	wnw.	....
3:51 p. m.....	718.3	10.6	83	wsw.	5.4	2160	590.8	9.1	......	wnw.	....
4:00 p. m.....	718.3	11.3	82	wsw.	6.3	1923	607.8	8.6	......	wnw.	....
4:31 p. m.....	718.1	12.3	80	wsw.	6.3	1378	648.8	9.8	......	w.	....
4:43 p. m.....	718.1	13.0	78	wsw.	6.7	950	683.0	12.6	......	w.	....
4:49 p. m.....	718.0	13.4	76	wsw.	7.2	689	704.3	14.0	......	wsw.	....
4:51 p. m.....	718.0	13.4	75	wsw.	7.2	526	718.0	13.4	75	wsw.	7.2

February 17.—Three kites were used; lifting surface, 19.4 sq. m. Wire out, 6000 m.; at maximum altitude, 5800 m.

The sky was overcast with St.-Cu. from the west-northwest at an altitude of 1800 m.

At 8 a. m. pressure was low over Lake Huron and high off the North Carolina coast.

February 18:											
8:34 a. m.....	714.4	6.5	94	nw.	9.8	526	714.4	6.5	94	nw.	9.8
8:40 a. m......	714.5	6.3	94	nw.	9.8	637	705.0	5.4	......	nw.	....
8:54 a. m......	714.6	6.2	88	nw.	8.0	761	694.4	4.9	......	nw.	....
9:03 a. m......	714.6	6.0	92	nw.	8.9	998	674.6	6.9	......	nw.	....
9:35 a. m......	714.5	5.1	100	nw.	10.7	1336	647.2	6.4	......	wnw.	....
9:44 a. m......	714.5	5.0	100	nw.	9.8	1887	604.8	4.2	......	wnw.	....
10:18 a. m......	714.5	5.1	100	wnw.	9.8	1568	628.8	5.0	......	wnw.	....
10:22 a. m......	714.5	5.1	100	wnw.	9.8	1400	641.8	4.7	......	wnw.	....
10:35 a. m......	714.5	5.0	100	wnw.	10.7	1215	656.5	5.4	......	wnw.	....
10:48 a. m......	714.5	5.0	100	wnw.	10.7	800	690.9	2.8	......	nw.	....
10:52 a. m......	714.5	5.0	100	wnw.	10.7	526	714.5	5.0	100	wnw.	10.7

February 18.—Four kites were used; lifting surface, 21.6 sq. m. Wire out, 3000 m., at maximum altitude.

There were 8/10 to 9/10 Nb. from the west-northwest and few low St. from the northwest before 9 a. m. These were followed by dense fog and rain at intervals.

The pressure was low over New Brunswick and Texas. Extreme high pressure prevailed over the northern Rocky Mountain and plains States and moderately high over the South Atlantic States.

Results of free air observations— Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. February 19:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:15 a. m.	716.6	—3.2	69	nw.	13.4	526	716.6	—3.2	69	nw.	13.4
8:23 a. m.	716.6	—3.2	69	nw.	12.5	904	683.0	—7.0	......	nw.	....
8:40 a. m.	716.6	—3.0	70	nw.	14.3	1072	668.6	—0.7	......	nnw.	....
9:01 a. m.	716.7	—3.0	74	nw.	10.7	1450	637.6	—3.7	......	nnw.	....
9:35 a. m.	716.6	—2.8	74	nw.	10.7	2000	594.3	—7.7	......	nw.	....
10:12 a. m.	716.5	—2.6	69	nw.	8.0	2268	574.3	—8.0	......	nw.	....
10:27 a. m.	716.5	—2.4	72	nw.	9.8	1688	618.5	—4.7	......	nw.	....
10:39 a. m.	716.5	—2.4	71	nw.	12.5	1266	652.3	—2.5	......	nnw.	....
10:52 a. m.	716.5	—2.3	69	nw.	13.9	925	681.2	—5.8	......	nw.	....
10:59 a. m.	716.5	—2.4	61	nw.	14.3	526	716.5	—2.4	61	nw.	14.3

February 19.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 4500 m.; at maximum altitude, 3500 m.

There were 7/10 to 9/10 A.-Cu. from the west-northwest. 2/10 to a few St.-Cu. from the same direction were visible after 8:56 a. m.

Pressure was high over Montana and low over Mississippi and New Brunswick.

February 20:											
1:26 p. m.	706.2	—1.0	96	nw.	7.2	526	706.2	—1.0	96	nw.	7.2
1:32 p. m.	706.2	—1.1	96	nw.	6.7	952	669.2	—4.1	......	wnw.	....
1:43 p. m.	706.2	—1.2	94	nw.	7.6	1412	631.0	—7.5	......	wnw.	....
1:56 p. m.	706.2	—1.4	96	nw.	9.8	1621	614.4	—8.2	......	wnw.	....
2:09 p. m.	706.4	—1.2	88	nw.	16.1	1232	645.7	—7.2	......	wnw.	....
2:19 p. m.	706.5	—1.1	83	nw.	19.7	954	669.2	—5.6	......	wnw.	....
2:53 p. m.	707.1	—1.2	69	nw.	22.4	526	707.1	—1.2	69	nw.	22.4

February 20.—Two kites were used; lifting surface, 12.6 sq. m. Wire out, 3000 m.; at maximum altitude, 2600 m.

There were 4/10 to 10/10 St. from the west-northwest at an altitude of 800 m. 2/10 to 5/10 A.-St. from the west-northwest were visible from 1:40 to 1:47 p. m.

Pressure was low over West Virginia and high over Quebec.

February 21:											
8:25 a. m.	719.0	—7.4	78	nw.	15.2	526	719.0	— 7.4	78	nw.	15.2
8:33 a. m.	719.0	—7.4	75	nw.	16.1	850	689.6	—11.0	......	wnw.	....
8:50 a. m.	719.2	—7.1	67	nw.	15.2	1176	660.9	—13.6	......	nw.	....
8:57 a. m.	719.3	—7.2	67	nw.	14.3	1590	625.8	—15.8	......	nw.	....
9:34 a. m.	719.3	—7.1	65	nw.	18.8	1700	616.8	—11.2	......	nw.	....
9:54 a. m.	719.3	—7.2	67	nw.	14.3	2036	590.3	—14.0	......	nw.	....
10:22 a. m.	719.3	—7.0	65	nw.	19.7	2323	568.4	—14.2	......	nw.	....
10:36 a. m.	719.3	—7.0	62	nw.	15.2	2008	592.7	—12.4	......	nw.	....
11:02 a. m.	719.3	—6.6	56	nw.	16.1	1662	620.4	—15.6	......	nw.	....
11:22 a. m.	719.2	—6.2	59	nw.	16.1	1482	635.2	—14.6	......	nw.	....
11:36 a. m.	719.2	—6.0	59	nw.	17.0	1200	659.1	—12.3	......	nw.	....
11:45 a. m.	719.1	—5.8	59	nw.	16.1	852	689.6	— 9.5	......	wnw.	....
11:49 a. m.	719.1	—5.2	57	nw.	16.1	526	719.1	— 5.2	57	nw.	16.1

February 21.—Four kites were used; lifting surface, 21.6 sq. m. Wire out, 5500 m.; at maximum altitude, 4500 m.

There were 7/10 to a few St.-Cu. from the northwest at an altitude of 1200 m.

Pressure was low over the Gulf of St. Lawrence and high over North Dakota.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
February 22:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:18 a. m.	715.5	−7.8	74	wnw.	17.0	526	715.5	−7.8	74	wnw.	17.0
8:24 a. m.	715.5	−7.9	75	wnw.	16.1	931	679.1	−11.5	......	wnw.	....
8:32 a. m.	715.4	−7.8	71	wnw.	17.0	1303	646.6	−13.4	......	nw.	....
8:45 a. m.	715.4	−7.8	71	wnw.	19.7	1577	624.2	−14.0	......	nw.	....
8:53 a. m.	715.4	−7.8	77	wnw.	14.3	1828	603.8	−14.3	......	nw.	....
9:04 a. m.	715.4	−7.6	74	wnw.	12.5	1929	595.9	−11.8	......	nw.	....
9:35 a. m.	715.2	−6.8	72	wnw.	11.6	1596	622.4	−13.4	......	nw.	....
9:58 a. m.	715.1	−6.5	68	wnw.	21.5	1240	651.9	−10.4	......	nw.	....
10:17 a. m.	715.1	−6.4	75	wnw.	10.7	1153	659.4	−12.6	......	wnw.	....
10:31 a. m.	715.0	−6.2	72	wnw.	17.9	805	689.8	−9.4	......	wnw.	....
10:41 a. m.	715.0	−5.8	69	wnw.	18.8	526	715.0	−5.8	69	wnw.	18.8

February 22.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 3500 m., at maximum altitude.

There were 4/10 to 6/10 St.-Cu. from the northwest.

The pressure was low over the Gulf of St. Lawrence and the St. Lawrence Valley. Pressure was high over the entire country with the exception of New York and New England.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.
February 23:											
1:29 p. m.	718.1	−0.6	......	wnw.	13.9	526	718.1	−0.6	......	wnw.	13.9
1:41 p. m.	718.0	−0.6	......	w.	13.4	984	677.7	−5.0	......	w.	....
1:47 p. m.	717.9	−0.1	......	w.	13.4	1199	659.4	−6.2	......	w.	....
2:26 p. m.	717.5	0.8	49	w.	13.4	526	717.5	0.8	49	w.	13.4

February 23.—Two kites were used; lifting surface, 12.6 sq. m. Wire out, 1500 m., at maximum altitude.

The sky was cloudless.

Pressure was low over the Gulf of St. Lawrence and was very high over Colorado and Wyoming.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.
February 24:											
8:23 a. m.	711.1	−1.0	67	w.	15.2	526	711.1	−1.0	67	w.	15.2
8:33 a. m.	711.0	−1.0	54	w.	16.1	1201	652.0	−4.6	......	wnw.	....
8:45 a. m.	711.0	−0.9	45	w.	16.1	1424	634.8	−2.3	......	wnw.	....
10:25 a. m.	711.0	1.2	44	w.	16.1	1878	599.5	−7.3	......	wnw.	....
10:30 a. m.	711.0	1.2	44	wnw.	16.1	2056	586.1	−6.3	......	wnw.	....
10:47 a. m.	710.9	1.2	48	wnw.	16.1	2375	562.4	−8.3	......	nw.	....
10:54 a. m.	710.9	1.3	42	wnw.	14.3	2612	545.1	−9.4	......	nw.	....
11:38 a. m.	710.9	1.5	45	wnw.	10.7	2267	569.7	−8.2	......	nw.	....
12:05 p. m.	710.8	1.8	45	nw.	12.5	1973	591.5	−7.0	......	nw.	....
12:15 p. m.	710.7	2.0	47	w.	10.7	1753	608.5	−7.4	......	wnw.	....
12:25 p. m.	710.6	2.1	50	w.	10.7	1444	633.0	−6.2	......	wnw.	....
12:43 p. m.	710.4	2.2	52	wnw.	10.7	935	674.9	−3.0	......	w.	....
12:52 p. m.	710.3	2.1	56	wnw.	10.7	526	710.3	2.1	56	wnw	10.7

February 24.—Two kites were used; lifting surface 12.6 sq. m. Wire out, 5000 m., at maximum altitude.

There were 2/10 to 5/10 Ci.-St. from the north, 2/10 to 4/10 A.-St. from the north-northwest before 11.30 a. m.

High pressure was central over Texas and low pressure over Maine.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
February 25:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:01 a. m.	714.3	3.2	45	w.	8.0	526	714.3	3.2	45	w.	8.0
8:11 a. m.	714.3	3.6	51	w.	8.5	980	675.3	1.2	......	w.	....
8:42 a. m.	714.3	4.8	41	w.	10.7	1649	622.2	6.3	......	wnw.	....
8:52 a. m.	714.3	4.8	41	w.	9.8	2108	588.4	5.0	......	nw.	....
9:14 a. m.	714.3	4.4	42	w.	10.3	2625	552.0	2.1	......	nw.	....
9:58 a. m.	714.3	5.0	46	w.	8.5	3668	484.6	−4.0	......	wnw.	....
10:46 a. m.	714.1	5.9	41	w.	9.4	4015	463.4	−7.3	......	w.	....
11:22 a. m.	714.1	7.0	39	w.	8.0	2755	543.8	1.1	......	wnw.	....
11:35 a. m.	714.1	7.4	35	w.	6.3	2294	575.7	4.1	......	nw.	....
11:50 a. m.	714.1	8.0	34	w.	6.7	2093	590.2	5.7	......	wnw.	....
12:00 m.	714.1	8.2	31	w.	6.3	1683	620.4	6.7	......	wnw.	....
12:13 p. m.	714.1	8.6	32	w.	6.7	1098	666.2	6.2	......	w.	....
12:21 p. m.	714.1	8.8	32	w.	6.7	526	714.1	8.8	32	w.	6.7

February 25.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 8000 m.; at maximum altitude, 7200 m.

There were 7/10 to a few A.-Cu. from the west-northwest before 10 a. m. and from the west thereafter.

Pressure was high over Georgia and low over South Dakota.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
February 26:											
7:56 a. m.	715.4	8.5	34	s.	6.7	526	715.4	8.5	34	s.	6.7
8:01 a. m.	715.4	8.5	34	s.	6.7	947	680.1	11.3	......	sw.	....
8:18 a. m.	715.4	8.8	31	s.	7.6	1599	628.8	6.5	......	sw.	....
8:31 a. m.	715.3	9.0	32	s.	7.6	2227	582.3	3.7	......	sw.	....
8:46 a. m.	715.3	9.2	34	s.	5.8	2896	535.8	−2.1	......	wsw.	....
9:11 a. m.	715.2	10.4	31	wsw.	4.9	3447	499.8	−6.3	......	wsw.	....
9:27 a. m.	715.1	10.8	33	se.	2.7	3871	473.3	−6.8	......	wsw.	....
9:44 a. m.	714.9	11.3	39	se.	2.7	4329	446.2	−9.3	......	wsw.	....
10:09 a. m.	714.8	12.6	29	wsw.	3.6	526	714.8	12.6	29	wsw.	3.6

February 26.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7300 m.; at maximum altitude, 7200 m.

There were 3/10 to 8/10 Ci.-St. and A.-Cu. from the west-southwest. St.-Cu., also from the west-southwest, appeared near the close of the flight.

At 8 a. m. pressure was low over the upper Lakes and high off the coast of Florida and Georgia.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
February 27:											
8:10 a. m.	720.5	7.2	63	wnw.	12.5	526	720.5	7.2	63	wnw.	12.5
8:20 a. m.	720.5	7.3	62	wnw.	13.4	935	685.5	4.0	......	wnw.	....
8:32 a. m.	720.7	7.2	63	wnw.	13.0	1424	645.2	−1.2	......	w.	....
8:50 a. m.	720.9	6.8	69	wnw.	10.7	1954	604.2	3.5	......	w.	....
8:58 a. m.	720.9	6.8	70	wnw.	12.1	2295	579.4	0.3	......	w.	....
9:24 a. m.	721.0	7.0	68	wnw.	10.7	1822	614.3	4.4	......	w.	....
9:48 a. m.	721.1	7.4	64	wnw.	12.5	1453	643.2	−0.8	......	w.	....
10:06 a. m.	721.1	7.3	62	wnw.	13.4	916	687.5	3.3	......	wnw.	....
10:15 a. m.	721.1	7.8	67	wnw.	13.4	526	721.1	7.8	67	wnw.	13.4

February 27.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4000 m., at maximum altitude.

There were about 7/10 Ci.-St., A.-St., and St.-Cu., all from the west. A solar halo was observed.

At 8 a. m. pressure was low over the Gulf of St. Lawrence and high over the Dakotas.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. February 28:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:17 a. m.	722.5	−4.1	68	wnw.	10.7	526	722.5	− 4.1	68	wnw.	10.7
8:26 a. m.	722.5	−4.2	68	wnw.	14.3	912	687.9	− 6.8	......	wnw.	....
8:37 a. m.	722.5	−4.3	69	wnw.	14.3	1202	662.8	− 5.1	......	wnw.	....
8:41 a. m.	722.5	−4.2	68	wnw.	15.2	1630	627.7	− 7.4	......	wnw.	....
8:53 a. m.	722.4	−4.1	68	wnw.	15.2	2253	579.4	− 5.0	......	wnw.	....
8:58 a. m.	722.4	−4.1	68	wnw.	15.2	2277	577.6	− 5.0	......	wnw.	....
9:09 a. m.	722.4	−4.0	68	wnw.	16.1	2227	581.2	− 6.4	......	wnw.	....
9:37 a. m.	722.5	−3.7	68	nw.	10.7	1625	627.7	− 4.4	......	wnw.	....
9:53 a. m.	722.5	−3.6	68	nw.	8.0	1464	640.7	− 7.4	......	wnw.	....
10:13 a. m.	722.5	−3.2	70	wnw.	6.3	1573	631.3	−11.1	......	wnw.	....
10:27 a. m.	722.0	−2.8	68	wnw.	10.7	1236	659.3	− 9.8	......	wnw.	....
10:43 a. m.	721.7	−2.2	63	wnw.	15.2	904	687.9	− 6.7	......	wnw.	....
10:51 a. m.	721.6	−2.2	63	wnw.	16.1	526	721.6	− 2.2	63	wnw.	16.1

February 28.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 3500 m., at maximum altitude.

There were 10/10 to 6/10 Ci.-St. from the west-northwest before 10 a. m. Thereafter the sky was covered with A.-St. and A.-Cu. from the west-northwest.

A high-pressure area of great extent was central over the Missouri Valley. Pressure was very low over Newfoundland.

March 1: Kite flight—											
12:00 m.	713.0	−0.3	45	wsw.	5.4	526	713.0	− 0.3	45	wsw.	5.4
12:28 p. m.	712.4	0.2	42	w.	6.7	800	688.3	− 4.0	......	wsw.	....
1:06 p. m.	711.7	0.3	51	w.	6.3	1608	620.1	− 9.2	......	w.	....
1:33 p. m.	711.2	2.2	43	w.	6.7	2381	561.3	− 5.5	......	w.	....
1:45 p. m.	710.9	2.6	37	w.	6.7	2677	540.3	− 7.4	......	w.	....
1:57 p. m.	710.7	2.9	31	w.	6.3	3183	506.2	− 8.1	......	w.	....
2:13 p. m.	710.4	2.3	41	w.	6.7	2700	538.5	− 8.6	......	w.	....
2:31 p. m.	710.1	1.9	51	wsw.	6.3	2073	583.2	− 4.7	......	wnw.	....
2:53 p. m.	709.8	2.7	39	wsw.	7.2	1903	595.9	−10.0	......	w.	....
3:13 p. m.	709.4	3.7	35	w.	6.7	1270	646.3	− 5.5	......	w.	....
3:23 p. m.	709.3	3.4	43	w.	6.3	939	673.7	− 1.4	......	w.	....
3:29 p. m.	709.3	3.5	30	w.	8.0	526	709.7	3.5	30	w.	8.0

March 1.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 4740 m., at maximum altitude.

There were 1/10 A.-Cu. and 4/10 A.-St. from the west. The latter had increased to 5/10 at 1:57, but had decreased to 1/10 by the end of the flight, at which time there were also 4/10 Ci.-St. from the west.

An extensive area of low pressure was central north of the upper Lake region, with a secondary depression over Georgia. High pressure was central in western Montana.

Balloon ascension—											
4:22 p. m.	....	....	......	....	....	701	....	....	......	n.65 w.	7.5
4:23 p. m.	....	....	......	....	....	876	....	....	......	s.89 w.	6.7
4:24 p. m.	....	....	......	....	....	1008	....	....	......	s.84 w.	7.5
4:25 p. m.	....	....	......	....	....	1141	....	....	......	s.80 w.	9.2
4:26 p. m.	....	....	......	....	....	1317	....	....	......	n.68 w.	8.3
4:27 p. m.	....	....	......	....	....	1493	....	....	......	n.64 w.	13.3
4:28 p. m.	....	....	......	....	....	1654	....	....	......	n.67 w.	8.3
4:29 p. m.	....	....	......	....	....	1816	....	....	......	n.71 w.	12.5
4:30 p. m.	....	....	......	....	....	2341	....	....	......	n.73 w.	12.5

One pilot balloon was used; ascensional force about 200 g.

There were 4/10 Ci.-St. and 1/10 A.-St., both from the west.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
March 2:	*mm.*	° *C.*	*%*		*m. p. s.*	*m.*	*mm.*	° *C.*	*%*		*m. p. s.*
8:29 a. m.	707.3	−0.1	58	w.	7.2	526	707.3	− 0.1	58	w.	7.2
8:36 a. m.	707.4	0.0	58	w.	8.0	967	669.2	− 3.8	......	w.	....
8:49 a. m.	707.4	0.0	57	w.	8.9	1402	633.0	− 7.6	......	w.	....
9:20 a. m.	707.5	0.0	65	w.	16.1	1945	590.2	−11.6	......	w.	....
10:29 a. m.	707.6	−0.5	66	wnw.	16.1	2564	544.1	−16.5	......	wnw.	....
11:05 a. m.	707.7	0.6	59	wnw.	19.7	4383	426.0	−24.1	......	wnw.	....
11:22 a. m.	707.8	0.4	55	wnw.	13.4	4855	399.5	−20.4	......	wnw.	....
12:53 p. m.	707.9	1.0	47	wnw.	17.9	3461	483.4	−19.7	......	wnw.	....
2:34 p. m.	708.4	1.2	51	nw.	14.3	2478	551.3	−14.7	......	wnw.	....
2:47 p. m.	708.4	1.8	50	wnw.	11.6	2032	584.8	−12.1	......	w.	....
3:04 p. m.	708.4	1.9	42	wnw.	13.4	1632	616.0	− 8.9	......	w.	....
3:19 p. m.	708.5	2.4	42	wnw.	22.4	1179	652.8	− 4.7	......	wnw.	....
3:37 p. m.	708.5	2.1	45	wnw.	20.6	526	708.5	2.1	45	wnw.	20.6

March 2.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 9500 m.; at maximum altitude, 9400 m.

St.-Cu., from the west-northwest, varied from 10/10 to 7/10 during the greater part of the flight, but diminished to 2/10 for a brief period about noon. There were snow flurries at 8:52, 9:14 to 9:20, 10:04 to 10:35, 11:30 to 11:50 a. m., 1:10 to 1:40, and 1:58 to 2:10 p. m. The head kite entered the base of the St.-Cu. at 8:46 a. m., altitude about 1400 m.; and fell below it at 2:36 p. m., altitude about 2100 m.

Low pressure was central over the lower St. Lawrence; high pressure over Texas.

March 3:											
Kite flight—											
8:05 a. m.	713.6	2.4	59	wsw.	5.8	526	713.6	2.4	59	wsw.	5.8
8:20 a. m.	713.7	2.9	56	wsw.	5.8	858	684.9	— 0.4	......	wsw.	....
8:47 a. m.	713.8	3.0	50	wsw.	5.8	1567	626.4	— 5.1	......	w.	....
9:00 a. m.	713.8	3.0	49	wsw.	5.8	2517	554.4	— 9.3	......	wnw.	....
9:18 a. m.	713.7	3.4	46	wsw.	5.8	2620	547.1	— 7.3	......	nw.	....
10:14 a. m.	713.5	4.6	40	wsw.	6.3	3389	495.6	—11.4	......	wnw.	....
10:37 a. m.	713.5	5.4	34	wsw.	5.8	4022	456.5	—15.4	......	wnw.	....
11:11 a. m.	713.4	6.1	36	wsw.	7.6	4328	438.2	—18.1	......	wnw.	....
11:47 a. m.	713.2	6.6	39	wsw.	9.8	4972	402.2	—21.2	......	wnw.	....
1:08 p. m.	713.0	8.1	40	wsw.	7.6	4343	438.2	—17.1	......	wnw.	....
1:49 p. m.	712.7	9.0	35	wsw.	7.6	3942	462.1	—14.5	......	wnw.	....
2:18 p. m.	712.5	9.9	34	wsw.	8.9	3379	497.4	—11.4	......	wnw.	....
2:35 p. m.	712.4	10.2	34	wsw.	9.4	2706	542.6	— 7.2	......	wnw.	....
3:07 p. m.	712.3	10.6	35	wsw.	8.9	2437	561.7	— 7.5	......	w.	....
3:13 p. m.	712.3	11.0	32	wsw.	9.4	2019	592.6	— 4.4	......	w.	....
3:24 p. m.	712.3	10.9	32	wsw.	10.3	1749	613.2	— 2.1	......	w.	....
3:34 p. m.	712.4	10.2	33	wsw.	11.6	1340	645.2	2.2	......	w.	....
3:51 p. m.	712.4	10.2	34	wsw.	10.7	832	686.6	7.9	......	w.	....
3:57 p. m.	712.4	10.0	34	wsw.	10.3	526	712.4	10.0	34	wsw.	10.3

March 3.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 13000 m.; at maximum altitude, 12700 m.

At the beginning of the flight there were a few St.-Cu., direction doubtful. Ci. and Ci.-St., from the west, appeared about 10 a. m. and increased to 5/10. After 2 p. m. there were also about 3/10 Cu. from the west at an altitude of 2600 m. A solar halo was observed.

At 8 a. m. a moderate high was central over the Gulf States and a very active low over the Gulf of St. Lawrence, with a secondary low over the lower Lake region.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. March 3: Balloon ascension—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:36 a. m.	......	......	......	......	......	806	......	......	......	s. 66w.	8.3
8:37 a. m.	......	......	......	......	......	1086	......	......	......	s. 66w.	8.3
8:38 a. m.	......	......	......	......	......	1366	......	......	......	s. 66w.	11.7
8:39 a. m.	......	......	......	......	......	1646	......	......	......	n. 82w.	14.1
8:40 a. m.	......	......	......	......	......	1926	......	......	......	n. 72w.	14.1
8:41 a. m.	......	......	......	......	......	2164	......	......	......	n. 66w.	16.7
8:42 a. m.	......	......	......	......	......	2402	......	......	......	n. 66w.	20.0
8:43 a. m.	......	......	......	......	......	2640	......	......	......	n. 66w.	20.8
8:44 a. m.	......	......	......	......	......	2879	......	......	......	n. 66w.	21.7
8:45 a. m.	......	......	......	......	......	3064	......	......	......	n. 60w.	26.6
8:46 a. m.	......	......	......	......	......	3249	......	......	......	n. 56w.	24.2
8:47 a. m.	......	......	......	......	......	3434	......	......	......	n. 56w.	23.3
8:48 a. m.	......	......	......	......	......	3620	......	......	......	n. 62w.	24.2
8:49 a. m.	......	......	......	......	......	3765	......	......	......	n. 68w.	26.7
8:50 a. m.	......	......	......	......	......	3910	......	......	......	n. 68w.	20.0
8:51 a. m.	......	......	......	......	......	4055	......	......	......	n. 71w.	21.7
8:52 a. m.	......	......	......	......	......	4200	......	......	......	n. 71w.	21.7
8:53 a. m.	......	......	......	......	......	4349	......	......	......	n. 71w.	21.7
Balloon ascension—											
4:10 p. m.	......	......	......	......	......	724	......	......	......	n. 61w.	3.3
4:11 p. m.	......	......	......	......	......	922	......	......	......	n. 79w.	6.7
4:12 p. m.	......	......	......	......	......	1120	......	......	......	n. 82w.	7.5
4:13 p. m.	......	......	......	......	......	1318	......	......	......	s. 87w.	7.5
4:14 p. m.	......	......	......	......	......	1516	......	......	......	n. 89w.	7.5
4:15 p. m.	......	......	......	......	......	1714	......	......	......	n. 83w.	6.7
4:16 p. m.	......	......	......	......	......	1912	......	......	......	n. 78w.	10.0
4:17 p. m.	......	......	......	......	......	2110	......	......	......	n. 83w.	10.4
4:18 p. m.	......	......	......	......	......	2308	......	......	......	n. 83w.	12.5
4:19 p. m.	......	......	......	......	......	2506	......	......	......	n. 83w.	13.5
4:20 p. m.	......	......	......	......	......	2704	......	......	......	n. 83w.	16.7

March 3.—One pilot balloon was used in each ascension; ascensional force about 200 g.

There were a few St.-Cu. from the west from 8:36 to 8:53 a. m. From 4:10 to 4:20 p. m. there were 5/10 Ci.-St. and 3/10 Cu., both from the west.

March 4:											
3:26 p. m.	717.4	−1.4	100	nw.	8.9	526	717.4	− 1.4	100	nw.	8.9
3:31 p. m.	717.4	−1.4	98	nw.	8.5	973	678.1	− 4.4	......	nw.	....
3:41 p. m.	717.5	−0.8	92	nw.	10.3	1338	647.4	− 6.0	......	wnw.	....
4:18 p. m.	717.9	−1.0	92	nw.	9.8	1806	610.0	− 9.6	......	wnw.	....
4:27 p. m.	718.0	−0.7	87	nw.	8.9	2071	589.4	−12.0	......	wnw.	....
4:31 p. m.	718.0	−0.5	86	nw.	8.9	2288	573.0	−10.3	......	wnw.	....
4:41 p. m.	718.1	−0.2	85	nw.	9.4	2583	551.2	−11.3	......	wnw.	....
5:11 p. m.	718.3	−0.2	81	nw.	10.7	2407	563.9	−14.0	......	wnw.	....
5:27 p. m.	718.7	−0.1	78	nw.	13.4	1878	604.6	−11.9	......	wnw.	....
5:52 p. m.	719.2	0.0	72	nw.	13.4	1512	634.6	− 9.0	......	wnw.	....
6:07 p. m.	719.2	−0.1	69	nw.	13.9	1140	665.5	− 5.9	......	nw.	....
6:15 p. m.	719.4	−0.2	71	nw.	12.1	891	687.1	− 3.8	......	nw.	....
6:19 p. m.	719.4	−0.3	69	nw.	12.1	526	719.4	− 0.3	69	nw.	12.1

March 4.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5600 m.; at maximum altitude, 5500 m.

The sky was nearly overcast with St.-Cu. from the west-northwest, at an altitude of 1700 m. Light snow fell from 4 to 5 p. m.

Pressure was low over eastern Virginia and high over southern Minnesota.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. March 5: First flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
11:09 a. m....	....	....	......	....	....	749	....	....	......	s.7 e.	1.0
11:10 a. m....	....	....	......	....	....	971	....	....	......	s.55 e.	1.7
11:11 a. m....	....	....	......	....	....	1194	....	....	......	s.5 e.	1.0
11:12 a. m....	....	....	......	....	....	1416	....	....	......	s.8 w.	1.0
11:13 a. m....	....	....	......	....	....	1636	....	....	......	n.68 w.	3.7
11:14 a. m....	....	....	......	....	....	1861	....	....	......	n.64 w.	5.3
11:15 a. m....	....	....	......	....	....	2084	....	....	......	n.63 w.	7.5
11:16 a. m....	....	....	......	....	....	2306	....	....	......	n.72 w.	8.7
11:17 a. m....	....	....	......	....	....	2529	....	....	......	n.74 w.	10.3
11:18 a. m....	....	....	......	....	....	2751	....	....	......	n.74 w.	11.3
11:19 a. m....	....	....	......	....	....	2974	....	....	......	n.74 w.	13.7
11:20 a. m....	....	....	......	....	....	3196	....	....	......	n.72 w.	18.3
11:21 a. m....	....	....	......	....	....	3429	....	....	......	n.64 w.	18.3
11:22 a. m....	....	....	......	....	....	3641	....	....	......	n.64 w.	23.3
11:23 a. m....	....	....	......	....	....	3864	....	....	......	n.53 w.	20.0
11:24 a. m....	....	....	......	....	....	4086	....	....	......	n.54 w.	18.3
11:25 a. m....	....	....	......	....	....	4309	....	....	......	n.52 w.	25.0
11:26 a. m....	....	....	......	....	....	4531	....	....	......	n 52 w.	28.3
11:27 a. m....	....	....	......	....	....	4754	....	....	......	n.52 w.	28.3
11:28 a. m....	....	....	......	....	....	4976	....	....	......	n.40 w.	28.3
11:29 a. m....	....	....	......	....	....	5196	....	....	......	n.36 w.	30.0
11:30 a. m....	....	....	......	....	....	5421	....	....	......	n.52 w.	31.7
11:31 a. m....	....	....	......	....	....	5644	....	....	......	n.37 w.	35.0
11:32 a. m....	....	....	......	....	....	5866	....	....	......	n.54 w.	33.4

March 5.—First flight: One pilot balloon was used; ascensional force about 200 g. The sky was cloudless.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
March 5: Second flight—											
2:42 p. m....	725.0	0.2	40	sse.	6.7	526	725.0	0.2	40	sse.	6.7
2:48 p. m....	724.9	0.2	43	sse.	5.8	870	694.2	−4.2	......	sse.	....
3:27 p. m....	724.7	0.8	41	sse.	6.7	1415	647.4	−7.2	......	ssw.	....
4:02 p. m....	724.5	0.5	57	sse.	8.9	1812	615.4	−2.0	......	wsw.	....
4:14 p. m....	724.3	1.2	51	sse.	8.9	2682	551.2	−5.8	......	w.	....
4:29 p. m....	724.1	1.8	35	sse.	8.9	3250	512.5	−7.6	......	nw.	....
4:47 p. m....	723.8	2.0	36	sse.	8.9	3094	522.8	−7.5	......	nw.	....
5:38 p. m....	723.2	1.1	40	sse.	8.9	2648	553.0	−5.1	......	wnw.	....
6:16 p. m....	722.9	−0.2	50	sse.	8.9	1984	601.0	−2.6	......	sw.	....
6:24 p. m....	722.9	−0.2	57	sse.	9.8	1752	619.0	−4.3	......	sw.	....
6:33 p. m....	722.8	−0.4	59	sse.	8.9	1799	615.4	−2.6	......	sw.	....
6:58 p. m....	722.7	−0.8	55	sse.	9.4	1159	667.3	−5.8	......	s.	....
7:32 p. m....	722.6	−1.3	65	sse.	8.9	785	699.5	−2.6	......	s.	....
7:40 p. m....	722.6	−1.4	68	sse.	10.7	526	722.6	−1.4	68	sse.	10.7

March 5.—Second flight: Three kites were used; lifting surface, 23.8 sq. m. Wire out, 4400 m., at maximum altitude.

There were 2/10 to 5/10 Ci. and Ci.-St. from the northwest before 6 p. m. and the sky was covered thereafter with Ci.-St. and A.-St. from the northwest.

An area of high pressure was central over the lower Lake region and Middle Atlantic States while pressure was low over Newfoundland and the upper Missouri Valley.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
March 6:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:26 a. m.	714.3	1.4	100	nw.	6.7	526	714.3	1.4	100	nw.	6.7
8:31 a. m.	714.4	1.2	100	nw.	7.2	751	694.9	5.0	......	nw.	....
8:45 a. m.	714.4	0.8	100	nw.	8.9	1138	662.7	4.6	......	nw.	....
8:58 a. m.	714.6	0.5	100	nw.	8.9	1653	622.2	3.6	......	nw.	....
9:14 a. m.	714.7	0.2	100	nw.	8.9	1997	596.3	1.6	......	nw.	....
9:24 a. m.	714.8	0.2	100	nw.	9.4	2083	590.2	2.6	......	nw.	....
9:36 a. m.	714.9	0.2	100	nw.	8.9	2491	561.1	−0.4	......	nw.	....
10:00 a. m.	715.1	−0.8	100	nw.	9.8	3130	518.2	−2.1	......	nw.	....
10:21 a. m.	715.3	−1.0	100	nw.	9.4	3435	498.7	−3.2	......	nw.	....
11:29 a. m.	716.0	−0.6	100	nw.	12.5	2646	550.2	0.4	......	nw.	....
12:04 p.m.	716.4	0.2	100	nw.	16.1	2004	596.3	1.4	......	nw.	....
12:13 p. m.	716.5	0.6	96	nw.	16.5	1739	616.2	2.5	......	nw.	....
12:16 p. m.	716.5	0.7	95	nw.	16.5	1661	622.2	−0.4	......	nw.	....
12:23 p. m.	716.6	0.9	91	nw.	16.5	1378	644.6	1.5	......	nw.	....
12:55 p. m.	717.0	2.8	93	nw.	13.4	1119	666.2	0.2	......	nw.	....
1:07 p. m.	717.1	3.9	84	nw.	15.6	526	717.1	3.9	84	nw.	15.6

March 6.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 7000 m.; at maximum altitude.

There was dense fog from 8:26 to 11:52 a. m. and light fog to 11:58 a. m. There were 3/10 to 10/10 St. from the northwest after 11:52 and 3/10 to a few A.-Cu. from the west-northwest after 12:22 p. m.

Pressure was low over Virginia and high over Ontario.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.
March 7:											
8:10 a. m.	726.7	−7.3	89	ese.	7.6	526	726.7	− 7.3	89	ese.	7.6
8:27 a. m.	726.6	−7.2	89	ese.	7.2	981	685.2	−10.4	......	se.	....
10:22 a. m.	725.7	−5.7	85	ese.	10.3	1397	649.0	− 2.4	......	sse.	....
10:39 a. m.	725.4	−5.6	85	ese.	10.3	1695	624.8	− 3.7	......	sse.	....
10:58 a. m.	725.2	−5.5	85	ese.	9.4	2430	569.1	− 4.3	......	s.	....
11:47 a. m.	725.0	−4.9	84	se.	8.9	2857	539.0	− 3.3	......	s.	....
11:57 a. m.	725.0	−4.8	82	se.	9.4	3226	514.1	− 6.3	......	ssw.	....
12:16 p. m.	724.6	−4.6	81	se.	10.7	2901	535.4	− 4.9	......	ssw.	....
12:29 p. m.	724.2	−4.5	81	se.	12.1	2515	561.9	− 3.3	......	s.	....
12:44 p. m.	723.8	−4.6	82	se.	10.7	2088	592.8	− 2.1	......	s.	....
1:01 p. m.	723.4	−4.5	79	se.	12.1	1597	630.2	− 4.1	......	sse.	....
1:09 p. m.	722.8	−4.5	79	sse.	13.9	1298	654.3	−11.0	......	sse.	....
1:19 p. m.	722.2	−4.5	79	sse.	13.9	978	681.5	− 9.4	......	sse.	....
1:28 p. m.	721.5	−4.4	79	se.	14.3	526	721.5	− 4.4	79	se.	14.3

March 7.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 6500 m.; at maximum altitude, 5500 m.

In the early part of the flight the sky was overcast with A.-St., from the south-southwest and a few St. from the southeast; altitude of St., 1000 m. Later the A.-St. were obscured by St.-Cu. from the south-southeast, their altitude increasing from 800 m to 1400 m. Light snow fell after 1 p. m.

High pressure was central over New England and low pressure over Missouri and Arkansas.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind Dir.	Wind Velocity.
March 8:											
3:30 p. m.	721.1	−2.7	100	nw.	5.8	526	721.1	−2.7	100	nw.	5.8
3:54 p. m.	721.1	−3.5	100	nnw.	5.4	659	709.1	−2.8	......	n.	......
4:38 p. m.	721.1	−2.9	98	nw.	5.4	919	686.2	−4.2	......	n.	......
4:47 p. m.	721.1	−2.9	98	nw.	5.4	526	721.1	−2.9	98	nw.	5.4

March 8.—Three kites were used; lifting surface, 24.3 sq. m. Wire out, 1200 m.; at maximum altitude, 1100 m.

There were 3/10 St.-Cu. from the north-northwest until about 3:30 p. m., after which the sky was clear.

A high pressure area was central over northern New York and Vermont, while pressure was low off the North Carolina coast and over the Canadian Northwest.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.	*mm.*	° *C.*	%		*m.p.s.*	*m.*	*mm.*	° *C.*	%		*m.p.s.*
March 9:											
8:15 a. m.	720.8	−1.0	54	sse.	6.7	526	720.8	−1.0	54	sse.	6.7
8:31 a. m.	720.8	−0.3	43	sse.	6.7	900	688.2	2.8	......	ssw.	....
9:00 a. m.	720.8	−0.1	41	sse.	6.7	1157	666.7	2.7	......	sw.	....
9:10 a. m.	720.7	0.1	38	sse.	6.3	1704	622.6	−1.3	......	sw.	....
10:45 a. m.	719.9	1.6	44	ssw.	4.5	2169	587.0	1.4	......	sw.	....
10:55 a. m.	719.8	1.7	46	ssw.	4.0	2603	556.0	0.5	......	sw.	....
11:30 a. m.	719.6	1.6	41	se.	8.9	2249	581.5	2.8	......	sw.	....
11:54 a. m.	719.4	2.0	42	se.	5.4	1460	641.0	0.5	......	sw.	....
12:09 p. m.	719.3	2.4	42	se.	8.5	904	686.5	3.6	......	ssw.	....
12:17 p. m.	719.2	1.9	37	se.	9.4	526	719.2	1.9	37	se.	9.4

March 9.—Six kites were used; lifting surface, 38.3 sq. m. Wire out, 6500 m.; at maximum altitude, 5900 m.

There were a few to 7/10 Ci.-St. from the west-northwest. Solar halo.

Pressure was high along the Atlantic coast and low over Missouri and north of Lake Superior.

March 10:											
10:48 a. m.	710.0	7.2	62	nw.	17.4	526	710.0	7.2	62	nw.	17.4
10:54 a. m.	710.0	7.4	64	nw.	16.1	937	675.3	5.0	......	wnw.	....
11:00 a. m.	710.0	7.6	65	nw.	17.9	1207	653.2	2.7	......	nw.	....
11:10 a. m.	709.9	7.8	57	nw.	20.6	1485	631.0	−0.1	......	nw.	....
11:30 a. m.	709.4	8.1	53	nw.	25.0	1587	622.6	0.4	......	nw.	....
12:38 p. m.	708.3	9.4	45	nw.	28.6	526	708.3	9.4	45	nw.	28.6

March 10.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4000 m.; at maximum altitude, 3400 m.

There were 3/10 St.-Cu. from the northwest.

Pressure was low over New York, New England, and the St. Lawrence Valley and high over the middle and upper Mississippi Valley.

March 11:											
2:52 p. m.	719.0	7.8	36	se.	7.2	526	719.0	7.8	36	se.	7.2
3:04 p. m.	719.0	8.3	37	se.	7.6	890	687.8	3.2	......	sse.	....
3:14 p. m.	718.9	8.4	30	se.	8.5	1058	673.6	1.6	......	sse.	....
4:41 p. m.	718.5	8.4	25	sse.	9.4	1630	627.6	5.4	......	s.	....
4:48 p. m.	718.5	8.2	26	se.	11.6	2187	586.6	5.2	......	sw.	....
4:55 p. m.	718.4	8.1	28	se.	11.2	2025	598.2	5.8	......	ssw.	....
5:03 p. m.	718.4	8.0	30	se.	12.1	1442	642.4	6.2	......	ssw.	....
5:08 p. m.	718.4	8.0	31	se.	10.3	1187	662.7	6.2	......	s.	....
5:13 p. m.	718.4	8.0	30	se.	11.6	945	682.6	3.8	......	sse.	....
5:22 p. m.	718.4	7.8	33	se.	11.2	526	718.4	7.8	33	se.	11.2

March 11.—Four kites were used; lifting surface, 30.6 sq. m. Wire out, 3150 m.; at maximum altitude, 2300 m.

There were a few Ci. from the northwest.

High pressure was central over the upper St. Lawrence, low pressure over Nebraska and Manitoba.

March 12:											
7:04 a. m.	716.3	0.3	69	sse.	8.5	526	716.3	0.3	69	sse.	8.5
7:10 a. m.	716.3	0.4	71	sse.	8.9	874	686.5	10.3	......	wsw.	....
7:29 a. m.	716.2	0.4	71	sse.	9.8	1523	635.7	15.8	......	w.	....
8:33 a. m.	716.1	0.9	74	se.	9.8	2538	563.3	8.1	......	w.	....
8:58 a. m.	716.1	1.1	76	se.	8.0	3351	510.1	2.2	......	w.	....
9:32 a. m.	715.9	1.9	76	se.	8.0	4527	439.8	−5.7	......	w.	....
10:54 a. m.	715.3	4.4	74	se.	8.0	3367	508.2	2.7	......	w.	....
11:31 a. m.	715.1	6.3	72	se.	7.6	2453	568.8	7.1	......	w.	....
11:47 a. m.	715.0	7.5	69	se.	7.6	1879	609.4	12.8	......	w.	....
12:08 p. m.	714.9	8.8	67	se.	8.5	1046	672.2	18.2	......	wsw.	....
12:17 p. m.	714.8	8.6	68	se.	8.9	526	714.8	8.6	68	se.	8.9

March 12.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 8000 m.; at maximum altitude, 7800 m.

Ci.-St., probably from the west, and A.-St. from the west, covered the sky.

High pressure was central off the north Atlantic coast. A trough of low pressure extended from Lake Ontario to Missouri.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
March 13:	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
8:21 a. m......	722.3	1.7	78	nw.	5.4	526	722.3	1.7	78	nw.	5.4
8:35 a. m......	722.5	1.6	80	nw.	6.3	1003	680.8	−0.8	......	n.	....
8:41 a. m......	722.5	1.5	75	nw.	6.7	1154	668.2	0.8	......	nne.	....
10:26 a. m......	723.3	1.0	78	ne.	5.4	1495	640.8	−2.4	......	ene.	....
10:28 a. m......	723.3	1.0	75	nw.	4.5	1681	626.0	−1.1	......	ene.	....
10:33 a. m......	723.4	0.9	70	nnw.	4.5	1583	633.7	−2.8	......	ene.	....
10:48 a. m......	723.7	0.9	70	nw.	5.4	992	682.8	0.5	......	ne.	....
10:56 a. m......	723.8	0.9	72	nnw.	4.5	830	696.9	−0.9	......	ne.	....
11:60 a. m......	723.9	0.8	72	nnw.	5.4	526	723.9	0.8	72	nnw.	5.4

March 13.—Five kites were used; lifting surface, 32 sq. m. Wire out, 5300 m.; at maximum altitude, 2300 m.

The sky was covered with A.-St. from the northeast.

Pressure was high over the middle Mississippi Valley and the Lake region and low over Georgia and the Carolinas.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
March 14:											
9:57 a. m.....	721.0	−0.6	73	ese.	7.2	526	721.0	−0.6	73	ese.	7.2
10:09 a. m.....	721.0	−0.6	77	ese.	6.3	929	685.4	−3.9	......	ese.	....
10:23 a. m.....	720.9	−0.6	79	ese.	7.2	1137	667.3	−5.1	......	se.	....
10:47 a. m.....	720.8	−0.2	81	ese.	6.3	1565	632.2	−0.2	......	se.	....
11:02 a. m.....	720.7	−0.5	83	ese.	5.8	1308	652.8	−5.1	......	se.	....
11:22 a. m.....	720.6	−0.7	86	ese.	4.9	1027	676.4	−5.4	......	se.	....
11:37 a. m.....	720.5	−0.6	88	ese.	4.5	526	720.5	−0.6	88	ese.	4.5

March 14.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 2700 m.; at maximum altitude, 2400 m.

There were 10/10 St. from the southeast. Snow fell from 10:12 to 10:35 a. m. and sleet after 11:11 a. m. The head kite entered the clouds at 10:45 a. m. at an altitude of 1500 m. and emerged at 11:21 a. m., altitude 1000 m.

Pressure was high over the New England coast and low north of Lake Superior.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
March 15:											
7:58 a. m.....	709.6	3.6	73	wsw.	8.5	526	709.6	3.6	73	wsw.	8.5
8:09 a. m.....	709.5	3.8	71	wsw.	7.6	890	678.5	3.4	......	w.	....
8:23 a. m.....	709.3	4.3	71	wsw.	8.5	1259	648.0	1.1	......	w.	....
8:34 a. m.....	709.2	4.9	63	wsw.	7.6	1607	620.6	1.8	......	w.	....
8:59 a. m.....	708.8	5.4	61	wsw.	7.6	2237	573.7	− 0.4	......	wnw.	....
9:37 a. m.....	708.4	6.1	64	wsw.	8.5	2730	539.1	− 1.4	......	w.	....
9:53 a. m.....	708.1	5.0	67	sw.	4.9	3338	498.7	− 6.1	......	w.	....
10:18 a. m.....	707.9	5.8	65	sw.	4.0	3826	467.9	− 9.2	......	wsw.	....
10:43 a. m.....	707.6	6.7	63	ssw.	3.6	4606	422.8	−14.0	......	wsw.	....
11:16 a. m.....	707.2	6.1	71	ssw.	5.4	4146	448.6	−11.2	......	wsw.	....
11:41 a. m.....	706.9	5.8	77	s.	7.2	3493	487.6	− 7.3	......	wsw.	....
12 m..........	706.6	6.6	75	ssw.	7.2	3132	510.7	− 5.6	......	wsw.	....
12:10 p. m.....	706.5	7.0	74	ssw.	7.6	2571	548.2	− 2.2	......	wsw.	....
12:28 p. m.....	705.9	8.2	74	ssw.	7.2	2306	566.4	− 0.4	......	wsw.	....
12:36 p. m.....	705.8	8.9	74	s.	6.7	2590	546.4	− 4.2	......	wsw.	....
12:45 p. m.....	705.4	9.6	73	s.	6.7	2224	571.9	− 1.7	......	wsw.	....
1:07 p. m.....	705.0	10.1	59	ssw.	9.8	1714	609.3	− 0.9	......	sw.	....
1:25 p. m.....	704.6	9.5	65	s.	8.9	1190	649.8	3.6	......	ssw.	....
1:32 p. m.....	704.5	9.4	66	sse.	8.9	795	682.0	6.1	......	s.	....
1:42 p. m.....	704.3	10.0	62	s.	8.0	526	704.3	10.0	62	s.	8.0

March 15.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 9000 m.; at maximum altitude.

At the beginning of the flight there was fog in the valleys east of the station. Ci.-St. from the west-southwest, appeared about 10 a. m. and increased, there being at the close of the flight about 9/10 Ci.-St. and A.-St., with a few St.-Cu., also from the west-southwest.

At 8 a. m. very active and well defined lows were central just east of Lake Huron and over Rhode Island. Pressure was high over the Gulf of St. Lawrence and the Dakotas.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
				Wind.						Wind.	
	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
1911.											
March 16:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1:40 p. m.	717.7	− 8.8	44	wnw.	15.6	526	717.7	− 8.8	44	wnw.	15.6
1:48 p. m.	717.7	− 8.5	50	wnw.	15.2	931	680.8	−13.9	......	wnw.	....
1:58 p. m.	717.6	− 8.2	46	wnw.	15.6	1471	633.7	−18.6	......	wnw.	....
2:13 p. m.	717.7	− 7.8	48	wnw.	13.4	1934	595.9	−14.8	......	wnw.	....
2:28 p. m.	717.7	− 7.3	54	wnw.	15.6	2338	564.9	−17.0	......	wnw.	....
2:46 p. m.	717.8	− 7.4	50	wnw.	17.0	1938	395.9	−14.5	......	wnw.	....
3:22 p. m.	718.0	− 6.9	47	wnw.	10.3	1732	612.8	−18.0	......	wnw.	....
3:46 p. m.	718.1	− 6.4	43	wnw.	10.7	937	680.8	−12.8	......	wnw.	....
3:54 p. m.	718.2	− 6.8	39	wnw.	10.7	526	718.2	− 6.8	39	wnw.	10.7

March 16.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4000 m.; at maximum altitude, 3700 m.

There were a few St. from the west-northwest.

Pressure was low over Nova Scotia and high over Indiana.

March 17:											
8:44 a. m.	723.1	− 6.0	62	sse.	5.8	526	723.1	− 6.0	62	sse.	5.8
9:02 a. m.	723.1	− 5.4	56	s.	5.4	830	695.6	− 7.0	......	ssw.	....
9:27 a. m.	722.9	− 4.8	53	sse.	6.7	1177	665.1	− 9.2	......	ssw.	....
9:51 a. m.	722.7	− 4.2	54	sse.	8.0	1303	654.1	− 9.6	......	ssw.	....
10:25 a. m.	722.4	− 2.5	39	sse.	9.4	1387	647.0	− 9.4	......	wsw.	....
10:28 a. m.	722.4	− 2.4	41	sse.	7.2	1684	622.8	− 7.2	......	wsw.	....
10:36 a. m.	722.4	− 2.0	44	sse.	8.9	2752	542.5	−11.7	......	wsw.	....
10:38 a. m.	722.4	− 1.9	44	sse.	8.9	2990	526.0	− 9.7	......	w.	....
11:15 a. m.	722.2	− 1.1	41	sse.	8.9	4143	452.7	−14.1	......	w.	....
11:24 a. m.	722.1	− 0.8	43	se.	8.9	4495	432.1	−16.9	......	w.	....
12:03 p. m.	722.0	− 0.6	50	sse.	9.8	4669	422.7	−18.2	......	w.	....
12:34 p. m.	721.6	− 0.2	56	sse.	10.7	4159	452.7	−14.5	......	w.	....
1:32 p. m.	720.7	0.5	54	s.	8.9	3434	497.4	−11.6	......	wsw.	....
2:11 p. m.	720.0	1.4	52	sse.	10.7	3233	510.3	−11.5	......	wsw.	....
3:05 p. m.	719.3	2.1	42	sse.	10.7	2413	567.1	− 7.6	......	wsw.	....
3:25 p. m.	719.0	2.0	42	sse.	10.7	1842	609.6	− 3.4	......	wsw.	....
3:42 p. m.	718.8	2.8	47	sse.	11.6	1060	672.4	0.3	......	sse.	....
3:48 p. m.	718.7	3.0	48	sse.	12.5	873	688.4	− 1.9	......	sse.	....
3:56 p. m.	718.6	2.8	37	sse.	15.2	526	718.6	2.8	37	sse.	15.2

March 17.—Five kites were used; lifting surface 32 sq. m. Wire out 10000 m.; at maximum altitude 9500 m.

There were 1/10 to 7/10 A.-St. from the west before 4 p. m., and 4/10 St.-Cu. from the west thereafter.

An area of high pressure was central off the North Carolina coast and an area of low pressure was central over the Gulf of St. Lawrence. Pressure was low from the Great Lakes to Texas.

March 18:											
8:46 a. m.	715.0	7.4	44	sw.	6.7	526	715.0	7.4	44	sw.	6.7
8:48 a. m.	715.0	7.6	43	sw.	6.7	694	700.6	8.5	......	wsw.	....
8:58 a. m.	715.1	8.3	41	wsw.	9.8	1286	652.2	4.9	......	w.	....
9:11 a. m.	715.1	8.9	40	w.	9.8	1743	616.7	1.4	......	w.	....
10:44 a. m.	715.7	9.0	49	wnw.	9.8	2434	565.2	− 5.6	......	w.	....
11:14 a. m.	716.0	8.4	54	nw.	11.6	1683	620.9	− 0.2	......	w.	....
11:29 a. m.	716.2	8.0	58	nw.	10.7	810	691.9	4.3	......	nw.	....
11:34 a. m.	716.2	7.7	62	nw.	10.3	526	716.2	7.7	62	nw.	10.3

March 18.—Four kites were used; lifting surface, 20.7 sq. m. Wire out, 6000 m.; at maximum altitude, 4600 m.

A.-St., from the west-southwest, diminished from 10/10 to 5/10 by 10:15 a. m. These gave place to St.-Cu., from the west, which almost covered the sky by the end of the flight. There was light smoke.

Pressure was low over New York, and was high from the upper Lakes to Texas and east of New England.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
March 19:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
3:26 p. m......	710.7	—1.3	100	se.	4.5	526	710.7	— 1.3	100	se.	4.5
3:34 p. m......	710.6	—1.0	100	se.	4.5	1237	650.7	4.9	......	w.	....
3:41 p. m......	710.6	—0.6	100	se.	5.4	1470	632.5	5.0	......	w.	....
3:51 p. m......	710.5	—0.4	100	sse.	5.8	1593	623.0	4.8	......	w.	....
3:52 p. m......	710.5	—0.4	100	sse.	5.8	526	710.5	— 0.4	100	sse.	5.8

March 19.—One kite was used; lifting surface 6.3 sq. m. Wire out, 2000 m.; at maximum altitude, 1900 m.

There was dense fog with rain.

A low pressure area was central north of Lake Superior. An area of high pressure was central off the Massachusetts coast.

March 20:											
8:17 a. m......	710.2	7.4	54	w.	8.9	526	710.2	5.4	5.4	w.	8.9
8:23 a. m......	710.2	5.4	56	w.	8.9	985	671.2	2.8	......	w.	....
8:39 a. m......	710.1	5.6	55	w.	8.5	1115	660.4	1.6	......	w.	....
9:00 a. m......	710.0	6.0	52	w.	7.2	1602	621.6	— 1.5	......	w.	....
10:25 a. m......	709.4	8.0	46	wsw.	7.6	2192	576.9	— 2.9	......	wnw.	....
10:31 a. m......	709.4	8.0	44	w.	8.5	2270	571.4	— 2.1	......	wnw.	....
10:37 a. m......	709.3	8.5	44	w.	8.5	2550	551.4	— 5.2	......	wnw.	....
10:47 p. m......	709.2	8.6	44	w.	7.6	2266	571.4	— 2.4	......	wnw.	....
10:56 a. m......	709.0	8.7	43	w.	8.9	2188	576.9	— 3.8	......	wnw.	....
11:27 a. m......	708.7	9.8	39	w.	8.9	1593	621.6	— 0.2	......	w.	....
11:35 a. m......	708.6	10.2	39	wsw.	11.2	1313	643.6	1.8	......	w.	....
11:44 a. m......	708.5	10.6	41	w.	9.8	866	680.0	6.2	......	wsw.	....
11:48 a. m......	708.4	10.0	38	w.	9.8	526	708.4	10.0	38	w.	9.8

March 20.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4500 m.; at maximum altitude, 4300 m.

The sky was cloudless until about 11:30 a. m., when a few St.-Cu. from the west-southwest appeared.

High pressure was central over Texas and an active low was central over New Brunswick.

March 21:											
9:49 a. m......	717.0	7.2	38	wnw.	15.2	526	717.0	7.2	38	wnw.	15.2
9:59 a. m......	717.1	7.4	36	wnw.	15.2	894	685.6	3.4	......	nw.	....
10:07 a. m......	717.1	7.6	36	wnw.	16.1	1130	665.8	0.9	......	nw.	....
10:20 a. m......	717.1	7.7	33	wnw.	15.2	1351	647.8	— 1.1	......	nw.	....
10:25 a. m......	717.1	7.9	32	wnw.	16.1	1703	620.0	1.2	......	nw.	....
10:42 a. m......	717.2	7.9	31	wnw.	16.1	2254	578.9	— 2.0	......	nw.	....
10:52 a. m......	717.2	8.2	29	wnw.	15.2	2613	553.4	— 1.6	......	nw.	....
11:17 a. m......	717.2	8.8	27	wnw.	8.0	3835	469.9	— 9.3	......	nw.	....
11:32 a. m......	717.3	9.3	26	wnw.	14.3	3086	521.4	— 4.6	......	nw.	....
11:47 a. m......	717.3	9.8	25	wnw.	10.7	2208	582.5	— 1.8	......	nw.	....
11:59 a. m......	717.3	10.2	24	wnw.	10.7	1595	629.0	— 0.7	......	nw.	....
12:11 p. m......	717.3	10.6	25	wnw.	10.7	847	689.2	5.4	......	wnw.	....
12:19 p. m......	717.3	10.6	24	wnw.	10.7	526	717.3	10.6	24	wnw.	10.7

March 21.—Three kites were used; lifting surface 16.2 sq. m. Wire out, 7000 m., at maximum altitude.

The sky was coudless.

An area of low pressure was central over the Gulf of St. Lawrence. Another storm area was central over Minnesota, while pressure was high from the lower Lakes to the Gulf of Mexico.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
March 22:	*mm.*	° *C.*	%		*m.p.s.*	*m.*	*mm.*	° *C.*	%		*m.p.s.*
7:59 a. m.	712.2	13.6	34	sw.	7.6	526	712.2	13.6	34	sw.	7.6
8:05 a. m.	712.1	13.7	37	sw.	6.7	984	674.5	13.3	......	wsw.	....
8:19 a. m.	711.9	13.4	35	sw.	6.3	1589	627.4	9.4	......	wsw.	....
8:35 a. m.	711.9	14.7	32	sw.	6.7	2152	585.9	6.2	......	wsw.	....
8:53 a. m.	711.4	16.0	31	sw.	8.9	2671	549.5	1.0	......	wsw.	....
9:18 a. m.	711.1	16.5	31	sw.	8.9	3362	503.6	− 3.7	......	wsw.	....
9:37 a. m.	710.8	16.9	30	sw.	7.6	4209	451.6	− 9.3	......	wsw.	....
10:07 a. m.	710.4	15.2	38	sw.	4.9	4769	419.8	−13.0	......	wsw.	....
10:31 a. m.	710.0	15.8	37	sw.	5.8	4108	457.2	− 8.9	......	wsw.	....
10:55 a. m.	709.7	16.9	36	sw.	5.8	3525	492.5	− 4.8	......	wsw.	....
11:15 a. m.	709.4	17.4	37	s.	4.9	2905	532.2	− 0.8	......	wsw.	....
11:36 a. m.	709.1	17.4	35	ssw.	7.2	2199	580.5	5.2	......	wsw.	....
11:50 a. m.	708.9	18.0	39	ssw.	6.7	1587	625.1	8.2	......	sw.	....
12:04 p. m.	708.6	18.7	32	ssw.	7.2	946	674.5	14.1	......	sw.	....
12:07 p. m.	708.6	18.8	32	s.	7.2	526	708.6	18.8	32	s.	7.2

March 22.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 9000 m.; at maximum altitude, 8100 m.

There were 4/10 to 9/10 A.-Cu. from the west and, after 11:15 a. m., 3/10 to 5/10 Ci.-St. from the west. Solar halo.

Pressure was low over Ontario and high along the south Atlantic coast.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
March 23:											
9:58 a. m.	716.3	−0.8	53	nw.	14.3	526	716.3	− 0.8	53	nw.	14.3
10:21 a. m.	716.3	−0.4	54	nw.	15.2	945	679.3	− 6.4	......	nw.	....
10:30 a. m.	716.2	−0.2	50	nw.	15.2	1325	646.9	− 9.6	......	nw.	....
11:06 a. m.	716.2	−0.2	44	nw.	14.3	1803	607.7	−14.0	......	nw.	....
11:25 a. m.	716.2	−0.2	47	nw.	19.2	2257	572.5	−16.1	......	nw.	....
11:30 a. m.	716.2	−0.2	48	nw.	17.9	2737	537.0	−16.5	......	nw.	....
11:43 a. m.	716.2	0.2	50	nw.	16.1	3256	501.0	−18.4	......	nw.	....
12:01 p. m.	716.2	0.3	51	nw.	16.1	3020	516.8	−17.6	......	nw.	....
12:20 p. m.	716.2	0.3	51	nw.	15.2	2836	529.6	−18.5	......	nw.	....
12:35 p. m.	716.3	0.4	52	nw.	15.2	2660	542.5	−18.1	......	nw.	....
12:57 p. m.	716.3	1.0	56	nw.	13.4	1872	602.3	−14.2	......	nw.	....
1:32 p. m.	716.3	−0.1	53	nw.	17.4	1373	642.9	−10.3	......	nw.	....
1:49 p. m.	716.3	0.6	51	nw.	17.4	864	686.5	− 5.4	......	nw.	....
1:59 p. m.	716.3	1.4	37	nw.	20.6	526	716.3	1.4	37	nw.	20.6

March 23.—Three kites were used; lifting surface, 16.2 sq. m. Wire out, 5000 m., at maximum altitude.

There were 7/10 to 8/10 St.-Cu. from the northwest at an altitude of 1800 m.

Very low pressure was central off New Brunswick and the New England States and high pressure over Minnesota and the Dakotas.

Date and hour.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Dir.	Velocity.
March 24:											
8:11 a. m.	724.0	−6.5	87	nw.	10.7	526	724.0	− 6.5	87	nw.	10.7
8:16 a. m.	724.1	−6.2	66	nw.	10.7	934	687.0	−10.4	......	nw.	....
8:44 a. m.	724.5	−6.0	64	nw.	14.3	1800	613.6	−15.4	......	nw.	....
8:56 a. m.	724.6	−5.6	61	nw.	12.5	2107	589.4	−14.4	......	nnw.	....
9:00 a. m.	724.7	−5.6	60	nw.	12.1	2395	567.6	−12.4	......	nnw.	....
9:15 a. m.	724.7	−6.0	54	nw.	11.6	2734	543.0	−10.8	......	nnw.	....
9:27 a. m.	724.7	−6.1	53	nw.	9.8	2757	541.1	−13.4	......	nnw.	....
9:51 a. m.	724.7	−5.2	52	nw.	9.8	2865	533.8	−13.2	......	nnw.	....
10:33 a. m.	725.0	−4.2	49	wnw	13.4	2718	544.8	−15.5	......	nnw.	....
11:02 a. m.	725.2	−4.2	50	wnw	15.2	2385	569.4	−13.3	......	nnw.	....
11:07 a. m.	725.2	−4.4	52	nw.	10.7	2337	573.0	−13.9	......	nnw.	....
11:26 a. m.	725.3	−3.6	48	nw.	10.7	1345	652.7	−11.9	......	nw.	....
11:43 a. m.	725.3	−3.6	47	nw.	10.7	970	685.3	− 8.4	......	wnw.	....
11:51 a. m.	725.4	−3.2	48	nw.	10.7	526	725.4	− 3.2	48	nw.	10.7

March 24.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 7000 m., at maximum altitude.

Cu. from the north-northwest, decreased from 5/10 and disappeared about 11 a. m.

A widely extended area of high pressure was central over Michigan. An active low pressure area was central off Newfoundland.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911. March 25:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7:59 a. m.	727.5	− 1.6	48	se.	6.3	526	727.5	− 1.6	48	se.	6.3
8:06 a. m.	727.5	− 2.0	40	se.	6.7	783	704.4	− 3.1	......	s.	....
8:30 a. m.	727.5	− 1.4	49	se.	6.7	1311	659.0	− 2.6	......	sw.	....
9:51 a. m.	727.3	0.2	46	se.	8.5	1442	648.3	− 0.6	......	sw.	....
10:06 a. m.	727.3	1.0	46	se.	8.0	1200	668.3	0.2	......	sw.	....
10:22 a. m.	727.2	0.7	43	se.	8.5	859	697.4	− 3.2	......	s.	....
10:25 a. m.	727.2	0.7	44	se.	8.5	526	727.2	0.7	44	se.	8.5

March 25.—Four kites were used; lifting surface, 25.7 sq. m. Wire out, 3700 m.; at maximum altitude, 2500 m.

There were 4/10 to 8/10 Ci.-St. from the west-southwest. Solar halo.

Pressure was high over eastern Maryland and low over Saskatchewan.

March 26:											
6:46 a. m.	723.6	1.3	58	s.	5.8	526	723.6	1.3	58	s.	5.8
6:49 a. m.	723.6	1.4	58	s.	6.7	608	716.3	4.9	......	s.	....
7:01 a. m.	723.6	1.7	57	s.	8.9	789	700.6	5.6	......	ssw.	....
7:10 a. m.	723.6	2.1	58	s.	7.2	1218	664.8	3.4	......	ssw.	....
7:19 a. m.	723.6	2.8	51	s.	8.9	1516	640.9	5.0	......	ssw.	....
8:05 a. m.	723.6	4.1	46	ssw.	7.2	2132	594.1	1.0	......	ssw.	....
9:28 a. m.	723.5	3.3	62	s.	4.9	2690	554.1	0.3	......	sw.	....
9:47 a. m.	723.4	3.1	64	s.	5.8	4120	461.6	− 8.3	......	sw.	....
10:20 a. m.	723.2	3.7	59	sse.	8.0	3428	504.4	− 4.4	......	ssw.	....
10:42 a. m.	723.0	3.9	60	se.	9.8	2853	542.2	− 1.3	......	ssw.	....
10:54 a. m.	722.8	4.3	59	se.	8.5	2243	585.0	0.7	......	ssw.	....
11:03 a. m.	722.8	4.4	58	se.	9.4	1914	609.3	0.7	......	ssw.	....
11:16 a. m.	722.8	5.4	54	se.	8.9	1410	648.5	3.7	......	ssw.	....
11:30 a. m.	722.7	5.4	54	se.	8.9	842	695.3	4.8	......	s.	....
11:35 a. m.	722.7	5.4	55	se.	9.4	526	722.7	5.4	55	se.	9.4

March 26.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 8000 m.; at maximum altitude, 6400 m.

The sky was overcast with Ci.-St. from the southwest. A solar halo was visible throughout the flight.

Pressure was high off the middle Atlantic coast and low over Iowa.

March 27:											
11:00 a. m.	707.1	9.6	100	se.	8.9	526	707.1	9.6	100	se.	8.9
11:07 a. m.	707.0	9.6	100	sse.	8.9	1085	661.5	15.9	......	sw.	....
11:21 a. m.	706.8	9.8	100	sse.	10.7	1512	629.0	14.6	......	sw.	....
11:27 a. m.	706.8	9.9	100	sse.	9.8	1792	608.5	11.9	......	sw.	....
11:41 a. m.	706.6	10.5	100	sse.	10.3	2311	571.6	6.1	......	sw.	....
11:53 a. m.	706.5	10.8	99	s.	8.0	2693	545.3	2.8	......	sw.	....
12:08 p. m.	706.3	11.1	98	s.	9.8	3041	522.2	− 0.8	......	sw.	....
12:19 p. m.	706.1	11.0	98	s.	8.9	3486	493.6	− 1.7	......	sw.	....
12:49 p. m.	705.4	11.5	96	s.	10.7	526	705.4	11.5	96	s.	10.7

March 27.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 6300 m., at maximum altitude.

Fog changed from dense to light about 11:30 a. m. and dissipated about 12 noon. There were 8/10 St. from the south.

A well-developed low was central over Lake Michigan and pressure was high over Texas and off the Atlantic Coast States.

March 28:											
1:09 p. m.	709.1	3.1	60	nw.	9.8	526	709.1	3.1	60	nw.	9.8
1:20 p. m.	709.1	3.2	62	nw.	10.7	886	678.1	−1.0	......	wnw.	....
2:21 p. m.	709.0	5.5	55	nw.	12.5	1329	641.6	−3.1	......	w.	....
2:41 p. m.	708.9	6.0	55	nw.	13.4	2226	573.0	−3.7	......	wnw.	....
3:03 p. m.	708.9	6.2	52	nw.	12.1	2688	541.1	0.2	......	wnw.	....
3:22 p. m.	709.0	6.6	52	nw.	12.1	2065	585.8	−2.0	......	wnw.	....
3:40 p. m.	709.0	6.7	56	nw.	9.8	891	678.1	2.7	......	w.	....
3:50 p. m.	709.1	6.4	55	nw.	9.4	526	709.1	6.4	55	nw.	9.4

March 28.—Two kites were used; lifting surface, 9.9 sq. m. Wire out, 4500 m.; at maximum altitude, 4100 m.

St.-Cu. diminished from 6/10, from the west-northwest, at the beginning to few after 3 p. m. After 1:30 p. m. the St.-Cu. moved from the west at a lower altitude. The head kite entered the St.-Cu. at 1:33 p. m.; altitude about 1600 m.

Very low pressure was central over Maine. Pressure was high over the Gulf States.

Results of free air observations—Continued.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Dir.	Velocity.					Dir.	Velocity.
1911.											
March 29:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8:10 a. m......	704.3	−1.0	88	se.	11.6	526	704.3	−1.0	88	se.	11.6
8:17 a. m......	704.3	−0.6	86	se.	11.2	814	679.3	−0.4	......	sse.	....
8:25 a. m......	704.2	−0.2	92	se.	10.7	1272	641.9	5.5	......	s.	....
8:37 a. m......	704.1	−0.6	92	se.	12.1	1753	605.0	3.2	......	ssw.	....
8:41 a. m......	704.1	−0.4	87	ese.	11.6	1909	593.6	4.2	......	ssw.	....
8:57 a. m......	704.0	−0.1	88	se.	10.7	2610	543.9	−1.1	......	ssw.	....
9:21 a. m......	703.5	0.4	84	ese.	9.8	2443	554.9	0.8	......	ssw.	....
9:35 a. m......	703.2	0.6	82	ese.	10.7	2097	579.2	−0.7	......	ssw.	....
10:00 a. m......	702.6	1.4	77	ese.	10.7	1716	606.8	2.6	......	ssw.	....
10:25 a. m......	702.1	2.2	70	ese.	12.5	1092	654.5	7.2	......	sse.	....
10:38 a. m......	701.8	2.5	71	ese.	8.9	704	686.4	−0.6	......	se.	....
10:41 a. m......	701.8	2.6	73	ese.	8.9	526	701.8	2.6	73	ese.	8.9

March 29.—Three kites were used; lifting surface, 16.2 sq. m. Wire out, 3500 m.; at maximum altitude, 3400 m.

The sky was from 5/10 to 8/10 covered with St.-Cu. and A.-St. from the south-southwest. Solar halo from 8:51 a. m.

A trough of low pressure extended from Minnesota to Kentucky. Low pressure was also central over the lower St. Lawrence.

March 30:											
8:13 a. m......	697.0	3.2	57	wnw.	17.0	526	697.0	3.2	57	wnw.	17.0
8:20 a. m......	697.0	3.2	60	wnw.	18.8	908	664.7	0.0	......	wnw.	....
8:30 a. m......	697.0	3.6	61	wnw.	16.1	1174	643.1	− 2.2	......	wnw.	....
8:50 a. m......	697.0	4.0	57	wnw.	19.7	1814	593.0	− 4.9	......	wnw.	....
9:04 a. m......	697.0	4.1	53	wnw.	20.6	2093	572.4	− 3.9	......	wnw.	....
9:22 a. m......	697.2	4.2	52	wnw.	20.6	2636	534.2	− 9.1	......	w.	....
9:40 a. m......	697.4	5.0	54	wnw.	13.9	2784	524.2	−10.9	......	w.	....
10:39 a. m......	697.8	4.8	55	w.	8.9	3260	492.0	−15.6	......	w.	....
10:56 a. m......	697.9	4.6	55	w.	7.6	2316	556.1	−10.9	......	w.	....
11:13 a. m......	697.9	5.0	52	w.	8.5	1671	604.4	− 6.9	......	wsw.	....
11:23 a. m......	697.9	5.2	49	w.	10.7	1161	644.9	− 2.4	......	w.	....
11:33 a. m......	697.9	5.6	52	w.	8.5	772	677.1	1.6	......	w.	....
11:41 a. m......	697.9	5.1	51	w.	11.2	526	697.9	5.1	51	w.	11.2

March 30.—Five kites were used; lifting surface, 27.9 sq. m. Wire out, 7700 m.; at maximum altitude, 6600 m.

There were 1/10 to 9/10 St.-Cu. from the west-northwest at an altitude of 2300 m. The direction changed to west by 9:40 a. m.

Pressure was low over New Hampshire and high over Kansas.

March 31:											
12:55 p. m.....	708.2	1.2	48	wnw.	19.7	526	708.2	1.2	48	wnw.	19.7
1:18 p. m.....	708.3	2.3	46	wnw.	14.8	936	672.8	− 4.1	......	wnw.	....
1:27 p. m.....	708.3	2.8	45	wnw.	13.4	1376	636.2	− 7.2	......	w.	....
1:46 p. m.....	708.4	2.4	48	wnw.	14.3	1634	615.4	−10.0	......	w.	....
2:18 p. m.....	708.4	1.8	50	wnw.	12.1	1965	589.4	−12.5	......	w.	....
2:47 p. m.....	708.4	2.0	39	wnw.	18.8	2895	521.0	−19.2	......	w.	....
3:41 p. m.....	708.6	2.4	40	wnw.	17.9	2280	565.7	−15.7	......	w.	....
4:08 p. m.....	708.7	1.8	42	wnw.	13.9	1683	611.8	−10.7	......	w.	....
4:30 p. m.....	708.8	2.2	46	wnw.	17.0	1051	663.7	− 4.2	......	wnw.	....
4:43 p. m.....	709.0	2.6	44	wnw.	17.0	526	709.0	2.6	44	wnw.	17.0

March 31.—Four kites were used; lifting surface, 21.6 sq. m. Wire out, 6400 m.; at maximum altitude, 5700 m.

There were 5/10 to 9/10 St.-Cu. from the west at an altitude of about 2000 m. Light snow fell from 12:45 to 1:10 p. m.

Very low pressure was central over the St. Lawrence Valley and relatively high pressure over the Southeastern States.

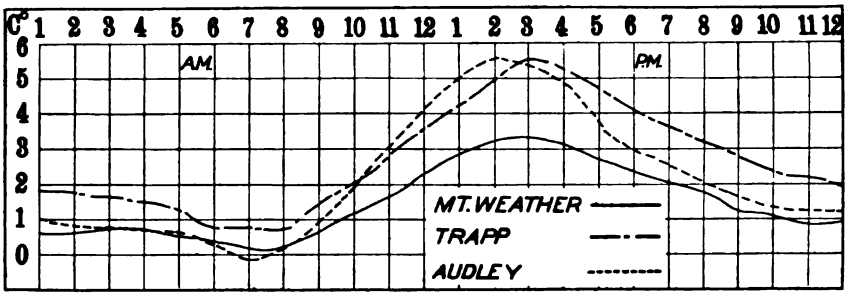

FIG. 1.—Mean hourly temperatures for January, 1911.

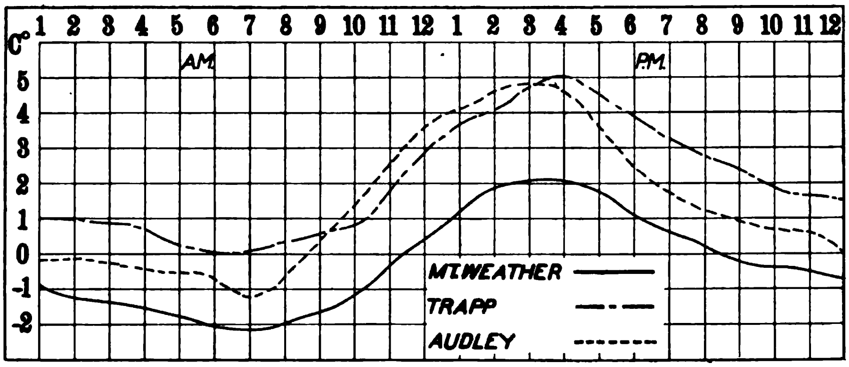

FIG. 2.—Mean hourly temperatures for February, 1911.

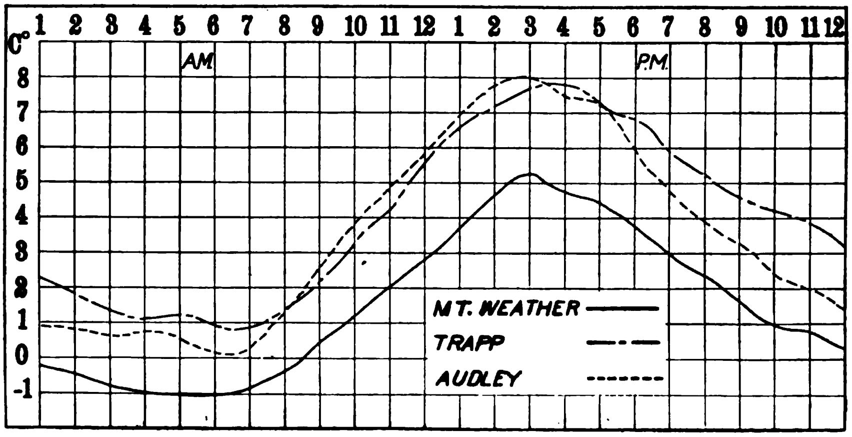

FIG. 3.—Mean hourly temperatures for March, 1911.

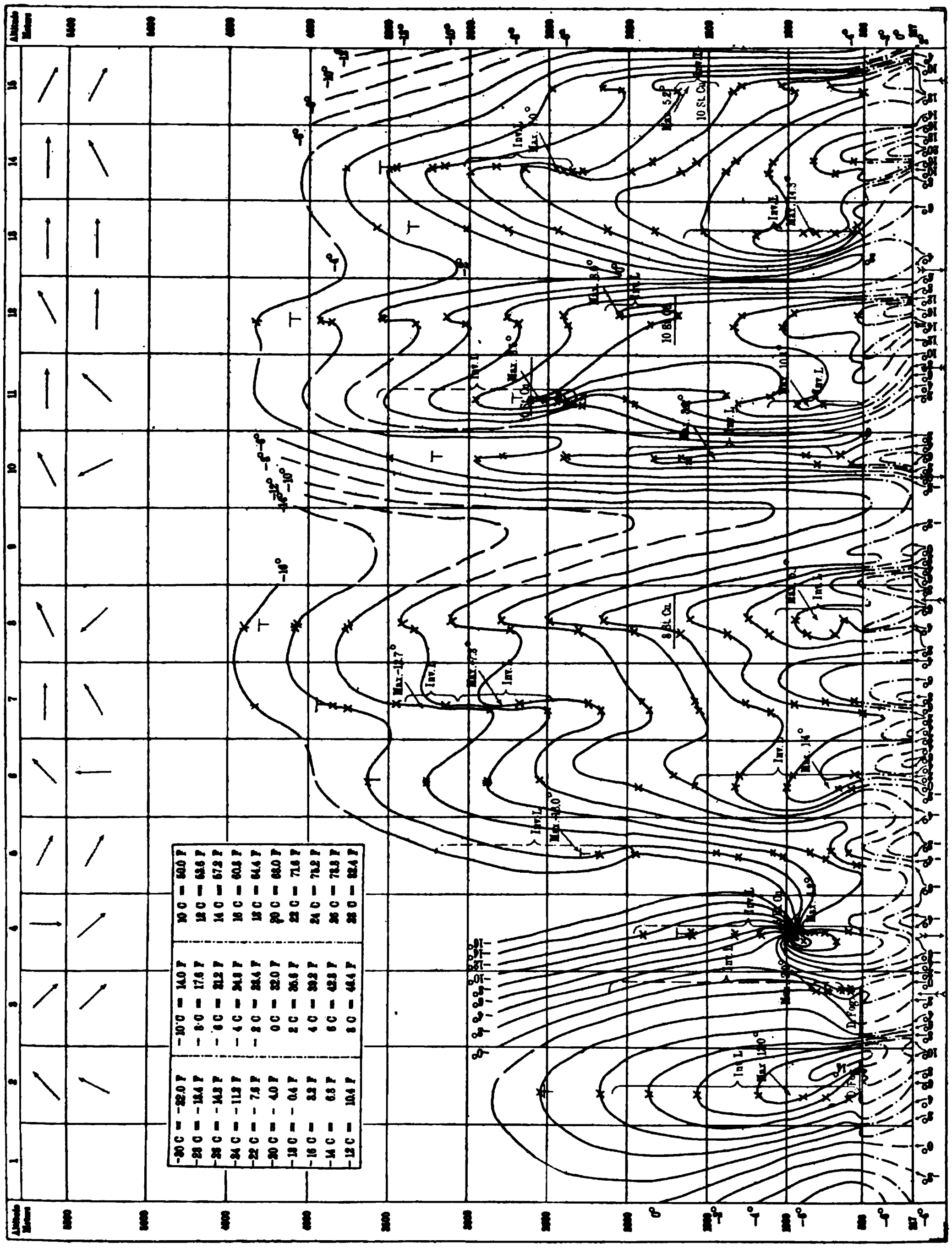

CHART I.—Free air isotherms, January 1-15, 1911.

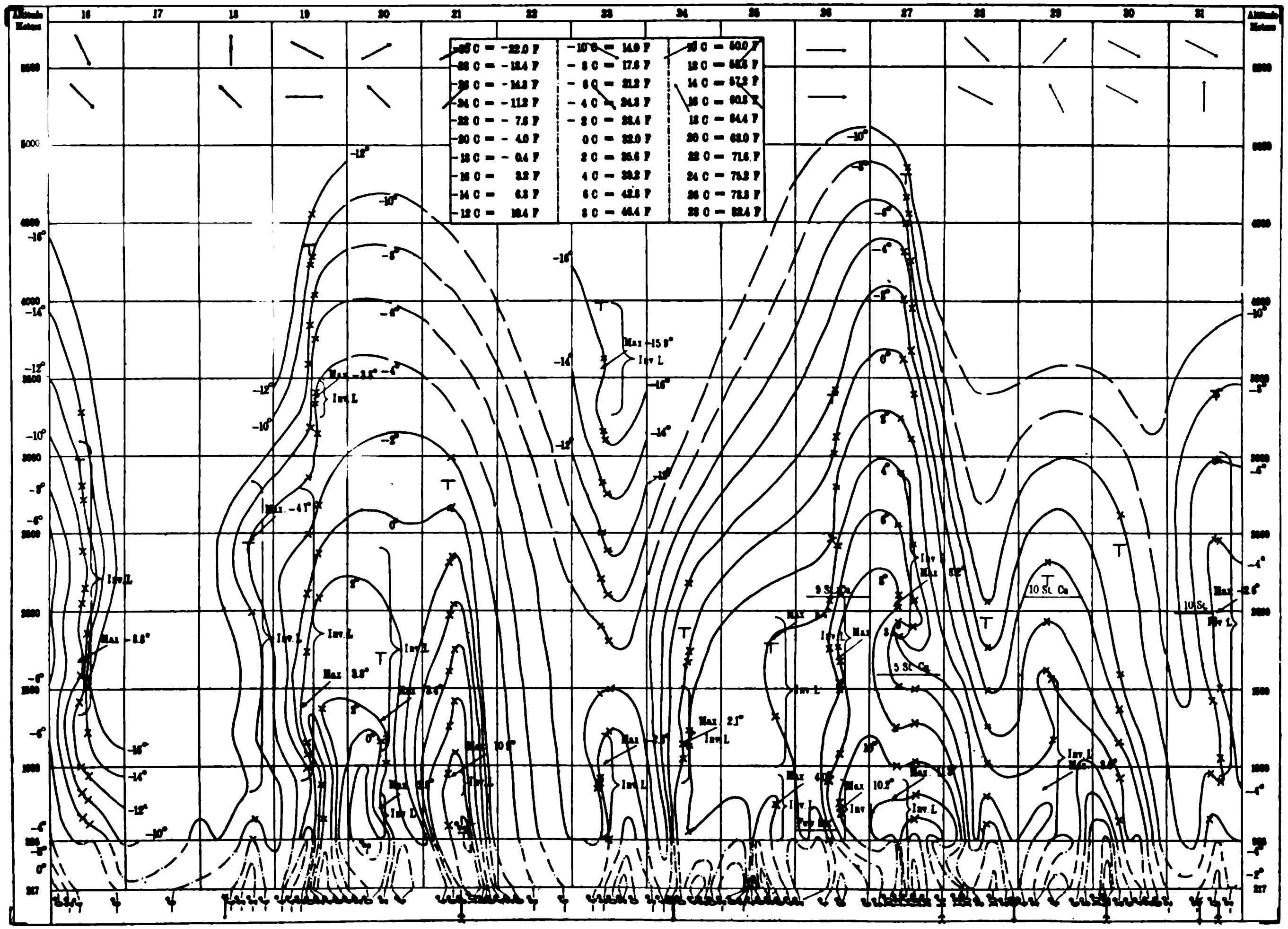

CHART II.—Free air isotherms, January 16–31, 1911.

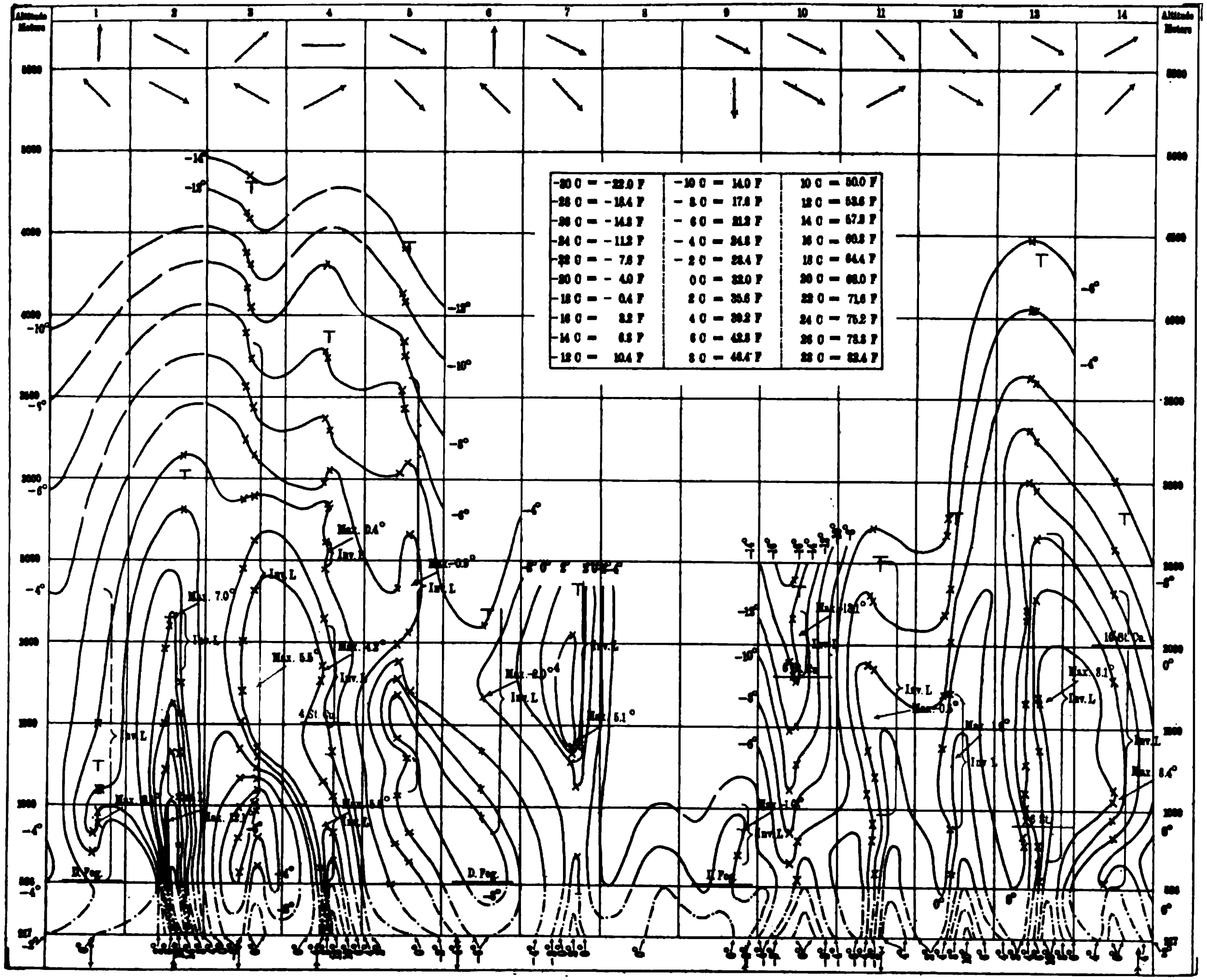

CHART III.—Free air isotherms, February 1-14, 1911.

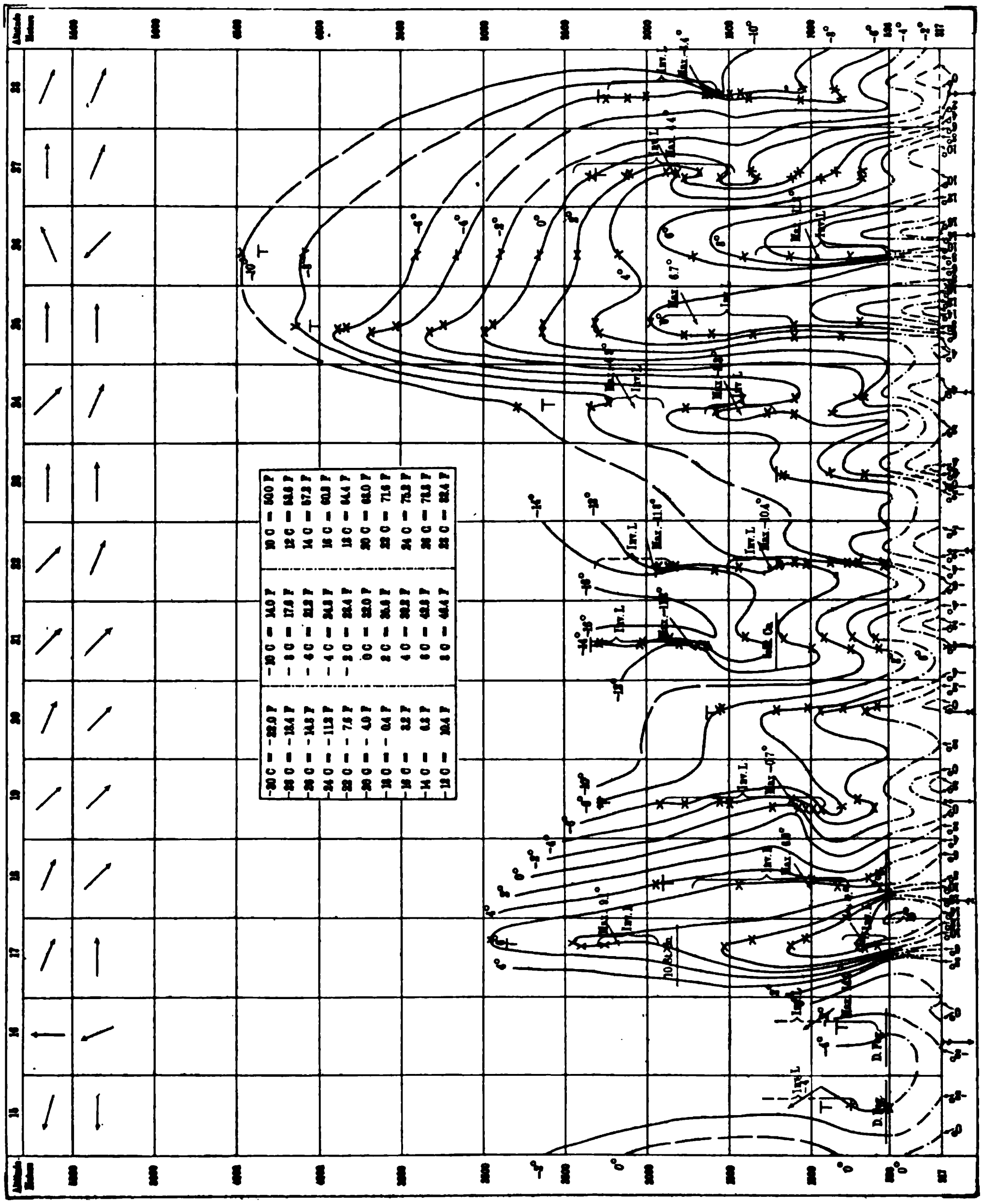

CHART IV.—Free air isotherms, February 15-28, 1911.

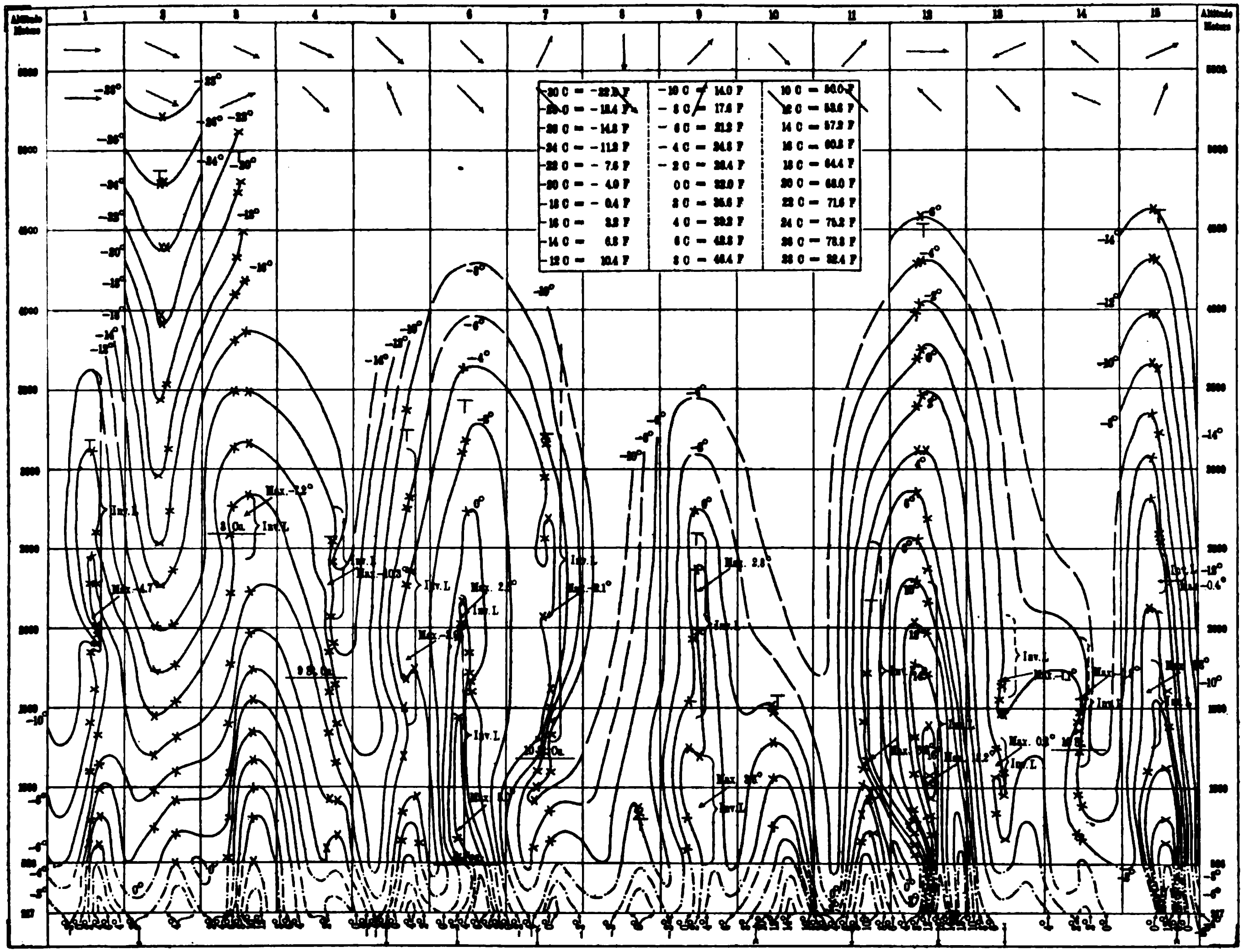

CHART V.—Free air isotherms, March 1-15, 1911.

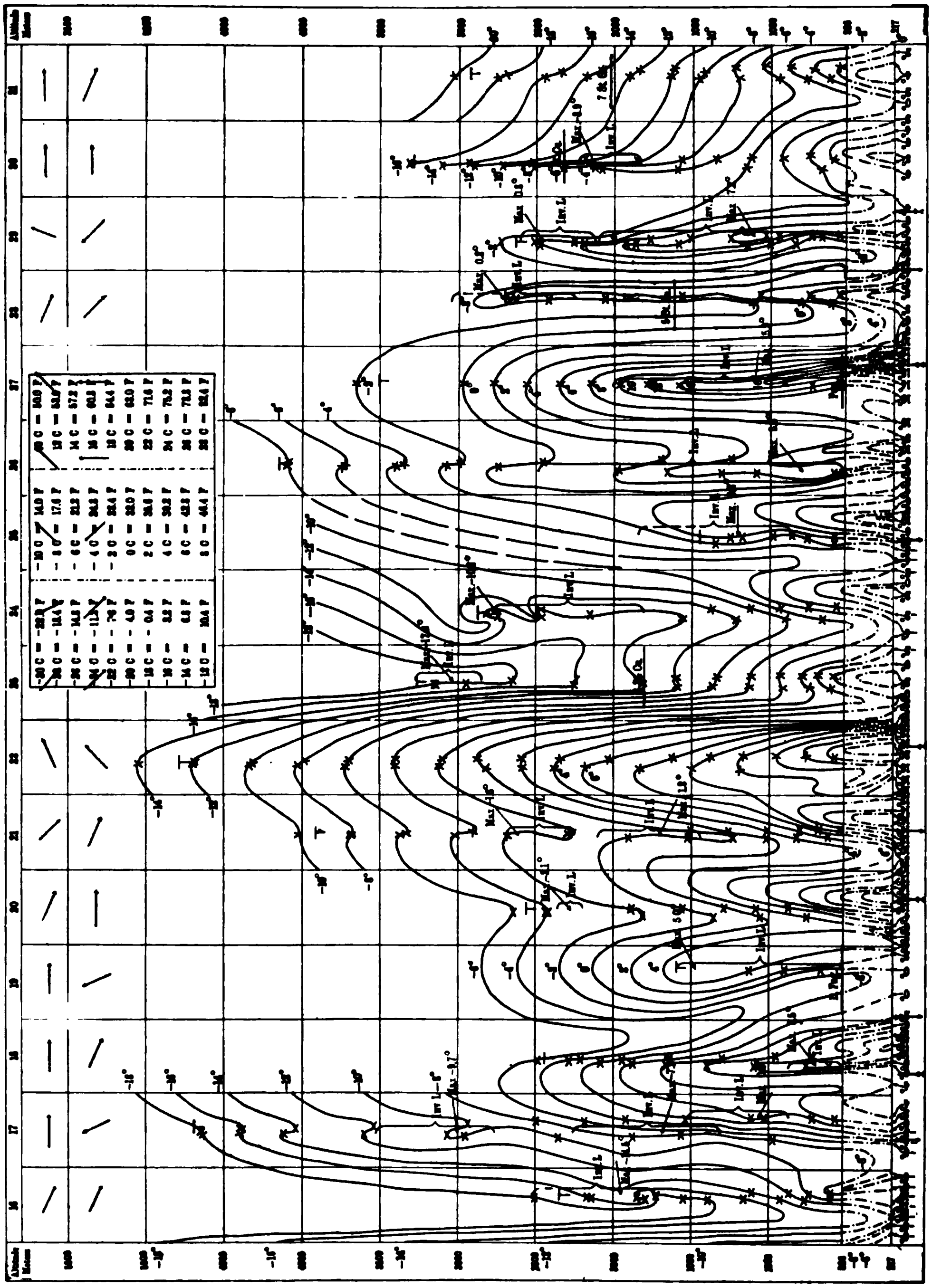

CHART VI.—Free air isotherms, March 16-31, 1911.

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U. S. DEPARTMENT OF AGRICULTURE

BULLETIN

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OF THE

MOUNT WEATHER OBSERVATORY

PREPARED UNDER THE DIRECTION OF
WILLIS L. MOORE, Sc. D., LL. D.,
CHIEF U. S. WEATHER BUREAU

WASHINGTON
GOVERNMENT PRINTING OFFICE
[illegible]

STAFF OF THE

MOUNT WEATHER OBSERVATORY

[illegible] .... [illegible], Washington, D. C.

[illegible] .... [illegible], Washington, D. C.

[illegible] .... [illegible], Washington, D. C.

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W. B. No. 466. CLEVELAND ABBE, Editor. Issued Nov. 5, 1911.

(VIII) VARIATIONS OF TEMPERATURE AT SUMMIT AND BASE STATIONS IN THE CENTRAL ROCKY MOUNTAIN REGION.

By Alfred J. Henry.

[Dated March 20, 1911.]

In a previous paper[1] the writer discussed the temperature and pressure changes between summit and base stations in the Central Rocky Mountain region. In that paper the discussion was based entirely on the conditions between the mountain stations and the stations on the plains to the eastward. Since that time the Mount Weather Observatory has established a special temperature station, at Fraser, Colo., on the western slope of the Rocky Mountains, 7½ miles (12 kilometers), in an air line, from the Continental Divide. The elevation of the station is 2,609 meters (8,560 feet), and it is 945 meters (3,100 feet), below the summit station at Corona. It is situated in what is locally known as Middle Park, one of those large elliptical bowls which find their greatest development in the mountain system of Colorado. It may be remembered that there are four great parks in Colorado, viz, North, Middle, South, and San Luis, the area of the latter being greater than that of the other three combined. The floor of Middle Park is probably between 2,286 and 2,438 meters (7,500 to 8,000 feet), above sea level, so that Fraser is not at the lowest point in the basin; it is, however, in a small valley, probably not over half a mile wide, with a narrow outlet toward the northwest. The main valley or basin, has the following topographic features: On the east and south it is bounded by the main chain of the Rocky Mountains; on the north by the Rabbit Ear Range, and on the west by The Williams Fork Range. Its drainage is to the southwest. The station is equipped with standard thermometers and a Richard thermograph, all exposed in a large size regulation thermometer shelter, which stands over sod. The observer is Mr. L. D. C. Gaskill.

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[1] Vol. III, this bulletin, part 4, pages 201-225.

It is probable that few places on the globe afford the opportunities for air drainage, that are to be had in the parks of Colorado. To the effects of this drainage of cold air from the mountain sides, and down the numerous small ravines, locally known as "draws," must be added the effect of the powerful nocturnal radiation which takes place under the clear skies and dry air of Colorado.

The summit station at Corona has an excellent exposure. The Denver Northwestern and Pacific Railroad (broad gauge), crosses the Continental Divide at this point at an elevation of 3,554 meters (11,660 feet), and the thermometers are about 40 feet higher than the railroad track. The mountains to the north and to the south are higher than at Corona, and as a result there is always considerable wind flowing through the pass. On account of the peculiar topography at these two stations, a study of their temperature records must be of great interest, although the results will be of special rather than of general application. The statistical matter published in this present paper is comprised in the following tables:

Table I, contains the hourly means of temperature for the single year of observations (1910) now available for Fraser, to which have been added similar values for the corresponding year for Corona. Table II, contains the so-called vertical temperature gradients between the two stations, deduced from the means given in Table I. The gradients given without algebraic sign indicate a decrease in temperature with altitude; those with negative sign indicate that the temperature was higher at the upper than at the lower station. Table III, contains similar data for the pair of stations, Corona and Denver. The latter, as is well known, is on the plains to the eastward of the mountains, and its thermometers are at an elevation above sea level of 1,630 meters (5,348 feet). Table IV, contains the synchronous temperatures at Fraser and Corona for the hours 2 a. m., and noon for the months of February and July. Other small tables have been inserted, whose purpose is clearly indicated by the text.

The main facts brought out in these tables are as follows: As might be inferred from the topographic features, the night temperatures at Fraser are lower than those for corresponding hours at Corona, not only on individual occasions, but also on the average, notwithstanding the difference of 945 meters (3,100 feet), in elevation. Such an inversion of temperature between mountain and valley stations has been noted in many cases in the literature of meteorology, and the phenomenon is a well known one, but most of the illustrations are drawn from the Alps. (See Prof. Hann's Handbuch der Klimatologie, Part I, English Translation by Ward.) In this country it has been found that at Blue Hill, "in the light winds of anticyclones, the air near the hill top is warmer than the valley air at night, but cooler than the free air at the level of the hill." (Clayton, Annals of the Astronomical College of Harvard College Observatory, Vol. LVIII, Part I, p. 11.)

Proceeding now to a consideration of the average temperature differences between the two stations, Corona and Fraser, Table I, we note that the night temperatures are lower at Fraser than at Corona, with a few exceptions, which will be considered later.

In individual cases the temperature at the lower station may be as much as 40° F. (22.22 C.), lower than that at the upper station. In general the course of the temperature at the two stations is parallel; but there are many exceptions, and the times of the daily maxima and minima are not always the same. So, too, the times of accidental maxima and minima are rarely the same. The great differences in the temperatures and the reversals of the usual gradient between an upper and a lower station is ascribed to the chilling of the surface air resting on the mountain sides and its subsequent drainage to the bottom of the basin, whence there is little opportunity for escape by gravity. Coupled with this cause, must also be ascribed the influence of nocturnal radiation under the clear skies and dry atmosphere of Colorado. The undue cooling at the lower station is apparently as effective in summer as in winter, but the very great individual differences above spoken of occur only in the anticyclonic weather of winter.

The lowest temperature at Fraser during the winter of 1909–1910 was −47° F. (−44 C.), at 7 a. m., December 17, 1909. At the same hour the temperature at Corona was −22° F. (−30 C.). The lowest temperature at Corona during the same winter was −30° F. (−34 C.), at the hours of 5, 6, and 7 a. m., February 17, 1910. The temperatures at Fraser for the corresponding hours were −17°, −18°, and −16° F. (−27, −28, and −26 C.).

The fact above stated that the average temperatures for the night hours were not always lower at Fraser than at Corona leads to the inference that the temperature distribution between two stations at different elevations is sometimes conditioned by circumstances other than local topography and difference in altitude. The differences in temperature between an upper and a lower station are always least at night and greatest during the warmer hours of the day. In the Rocky Mountain region it seems that the vertical temperature distribution depends largely upon whether the weather is under the control of cyclonic or anticyclonic conditions. Thus, in cyclonic weather there is greater movement in the lower layers of the atmosphere than in anticyclonic, and this movement, especially in a vertical direction, tends to create a temperature gradient closely approximating adiabatic conditions. We may at this point anticipate the discussion somewhat by referring the reader to Table II, wherein the afternoon temperature gradients between Fraser and Corona are shown to be almost equal to, and in some cases even in excess of, the adiabatic rate for dry air, viz, 1° C. per 100 meters.

The surface air in the park at Fraser is warmed very rapidly after the sun rises and soon must tend to rise as in the case of the mountain-valley winds described by Dr. Hann in Handbuch der Klimatologie, english translation by Ward, pages 333–338. Ascending currents from the valley floor must, as soon as they reach the altitude of the rim of the basin, intermingle with the prevailing westerly winds at that height and blow directly across the mountain pass in which Corona is situated. These winds have been chilled by adiabatic expansion and on arriving at Corona have the temperature proper to the difference in elevation between the two places. In cyclonic weather ascensional currents are more likely to develop than in anticyclonic, and there is more cloudiness. As already stated, these phenomena tend to produce a temperature gradient that closely approximates the adiabatic. On the other hand, anticyclonic control of the weather tends to produce a vertical temperature gradient that in the case under consideration approaches zero. Clear anticyclonic weather is favorable to nocturnal radiation, followed by air drainage, and these processes tend to overcome the natural vertical gradient between Fraser and Corona, due to difference in elevation. An example from the actual readings during anticyclonic weather will make this clear. On the night of August 25–26, 1910, an anticyclone crossed the central Rocky Mountain region and the next day at 8 a. m. was central in the lower Missouri Valley, the high pressure extending westward over Colorado. The actual hourly temperatures, in Fahrenheit degrees, for the day at Corona and Fraser illustrate so fully the remarkable differences between this pair of stations that they are here given in full:

Hourly temperatures at Corona, 3,554 meters, and Fraser, 2,609 meters, on August 26, 1910, anticyclonic conditions.

	Corona.	Fraser.		Corona.	Fraser.
	° *F.*	° *F.*		° *F.*	° *F.*
1 a. m.	40	22	1 p. m.	55	72
2 a. m.	40	20	2 p. m.	56	73
3 a. m.	40	18	3 p. m.	57	73
4 a. m.	40	17	4 p. m.	56	73
5 a. m.	41	15	5 p. m.	55	73
6 a. m.	42	25	6 p. m.	52	70
7 a. m.	45	34	7 p. m.	48	50
8 a. m.	47	46	8 p. m.	47	48
9 a. m.	51	56	9 p. m.	46	45
10 a. m.	53	61	10 p. m.	45	36
11 a. m.	55	64	11 p. m.	43	35
12 noon	57	72	12 midnight	42	32
			Mean	47	48

The greatest hourly difference between the above readings was 26° F. (14.44° C.) at 5 a. m., and the average difference, plus or minus, was 13° F. (7.22° C.), while the difference in the mean daily temperature was only 1° F. (0.56° C.), and the mean gradient between the two places on that day was 0.06° C. per 100 meters.

If now we apply the principles enunciated in the foregoing to the exceptional temperature differences of February and November, we shall find that for February, 1910, the weather over Colorado was under anticyclonic control on 18 days and under cyclonic control on the remaining 10 days, while in November of the same year cyclonic control dominated. In consequence we find a negative temperature gradient throughout the 24 hours, as we would expect.

When a cyclone passes eastward, either directly over Colorado or far to the northward, there is a lag in the time of occurrence of the high surface temperatures at the lower stations as compared with the upper.

The surface air in cyclones which traverse the Rocky Mountain region, as elsewhere in the United States, is relatively warm even at the altitude of Corona, as abundant observations show. The relatively high temperatures, however, do not persist after the center of the cyclone passes to the eastward of the station, and this is true whether an anticyclone closely follows the cyclone or not. The temperature at a high station falls also whenever precipitation occurs at or near the station. On the other hand, the warming at a lower station generally takes place 24 hours after the rise at a high-level station, which is in close proximity. Perhaps the best use the forecaster in the Rocky Mountain region makes of the high-level readings is to determine the approach of a cyclone, since in the Rocky Mountain region at least the rise in temperature in the advance of a cyclone appears to take place in the upper levels before it does in the lowlands.

The most frequent weather type bringing snow and high winds in Colorado and New Mexico in winter is the pressure distribution which accompanies a cyclone central over southern Utah, northern Arizona, or southwestern Colorado, separated by the Rocky Mountains from a strong anticyclone that moves southeastward from Montana. This distribution of pressure, a high on the eastern side of the mountains and a low west of them, is attended by heavy snow in the mountains and even on the plains far to the eastward, which often continues for several days. It has been observed that when the temperature at the high-level stations is falling the western depression will not cross the mountains; it either fills up or slowly drifts eastward over the lower levels of southern New Mexico.

The general movement of the atmosphere in the Rocky Mountain region is from the west. There is, however, considerable easterly movement of the wind, apparently as an indraft toward cyclones advancing from the Pacific. Such indraft must be looked for on the high plains of Wyoming and New Mexico but not on the highest summits of the central Rocky Mountains. Thus, for example, on the high plains of Wyoming, where the altitude does not greatly exceed 2,194 meters (7,200 feet), as at Laramie, Wyo., the record of easterly winds from 3 years' automatic registry is as much as 24 per cent, and of this more than half is from the southeast. At Pikes Peak, the highest point from which records are available, only 1 per cent of the wind movement is from the southeast, and at Corona an east wind is rarely observed. The mean direction of the wind for winter at Pikes Peak is N. 73° W.; Corona, S. 86° W.; Laramie, Wyo., S. 53° W.

In considering the movement of the air across the Rocky Mountains it is important to examine the diurnal variation of the direction of the wind, particularly on the plains directly east of the mountains. For this purpose figure 1 was constructed from the automatic recording sheets at Pikes Peak, Denver, and Colorado Springs for the winter months only. The wind at the Peak veers a little in the daytime, from west to west-northwest and back again in the afternoon. At the plains stations there seems to be a wind blowing obliquely toward the mountains in the afternoon, and away from the mountains at night. District Forecaster Brandenburg says that a similar movement obtains to the Kansas line. (Bulletin Q, Climatology of the United States, p. 861.) The trend of the mountains in eastern Colorado is very nearly north and south. At Colorado Springs it will be noticed from figure 1 that the winds in the night and early morning hours blow very nearly parallel to the mountains, being southerly directed; in the afternoon hours they blow obliquely toward the mountains from a point a little east of south.

From these brief considerations of the air movement across the mountains, we now turn to the temperature decrease with altitude, as shown in Tables II and III.

The decrease of temperature between the summit of the Rocky Mountains and stations on the plains to the eastward may be taken as characteristic of that which obtains in the interior of a continent far removed from the source of moisture and in air that has, therefore, only a small per cent of moisture. A distinction should also be made between the west and the east slopes of the mountains. On the western slope the lowest layers of air, those in contact with the earth's surface, must rise as they cross the divide, while on the eastern slope the tendency will be for the air to sink toward the plains by reason of the low temperature it has attained in its ascent on the windward side.

The average rate of decrease in temperature between Corona and Denver for each hour of the day will be found in Table III, at the bottom of which has been added, for the sake of easy reference, the average rate of temperature decrease for each month of the year at another pair of stations on the leeward slope of the mountains, viz, Pikes Peak and Colorado Springs, Colo.; and also for a pair of stations in the Austrian Alps, viz, the summit of the Sonnblick, elevation 3,105 meters, and Kolm-Saigurn, elevation 1,605 meters.[1]

The average annual gradient between Corona and Denver for a single year's observations is 0.707 C. per 100 meters, a little higher than that already found for the pair of stations, Pikes Peak and Colorado Springs, from about two years' observations, viz, 0.660 C. per 100 meters. For the Swiss Alps, J. Maurer has found a final mean gradient of 0.510 C. per 100 meters for the northern slope and 0.588 C. for the southern, while Hann found 0.507 C. for the northern and 0.600 C. for the southern slope of the Austrian Alps. The gradients between the summit of the Sonnblick and Kolm-Saigurn are in fair agreement with those of eastern Colorado when the climatic differences between the two places are taken into consideration. The smallest gradient occurs in the winter months and the largest in the spring months at both places. The gradients at Colorado stations in the afternoon hours of summer closely approximate the adiabatic rate for dry air. This is true only for summit stations and plains stations to the eastward. On the other hand, the decrease of temperature with increase of altitude on the western slope of the mountains, so far as Fraser can be said to represent the western slope, exceeds the adiabatic rate for dry air in the afternoon hours from August to November and is about equal to it in July of the year under consideration. The large gradient in the afternoon hours is believed to be due to the great heating of the surface air on the floor of the basin in which Fraser is situated.

Surface heating begins an hour or so after sunrise. It reaches its maximum hourly amount in summer, 5.28° C., between the hours of 7 and 8 a. m. The nearest approach to so great a change in the air temperature during the diurnal period in summer is at Santa Fe, N. Mex., a high plateau station, where it amounts to 2.83° C. between 6 and 7 a. m. The greatest hourly change at Corona in summer is but 2° C., and the time of occurrence is later in the day. The numerical values of the loss of heat from one hour to the next as indicated by the hourly mean temperatures are not so great as those of the gain in heat, but there are more hours when the temperature of the air is falling than when it is rising. In both winter and summer the time of greatest gain in heat during the diurnal period occurs earlier at the lower than at the higher stations throughout the Rocky Mountain region. This would indicate a lag in the time of the daily maximum temperature at the higher stations. The records themselves are too short to afford definite conclusions on this point.

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[1] Der Tagliche Gang der Temperatur und des Sonnenscheins auf dem Sonnblickgipfel. W. Trabert, Wien, 1892.

The diurnal range of temperature at Fraser, like other Colorado stations, is among the greatest to be found in the United States. It is closely followed by the record at Salida, Colo., a station in the valley of the Arkansas, 55 miles from the western edge of the Great Plains. The geographical coordinates of Salida are about as follows: Latitude 38° 30″ north; longitude 105° 55″ west; altitude 2,144 meters. The river valley is generally narrow and mountains rise on either side. At Salida where the observations are made it opens out for a short distance to a width of 3 or 4 miles. Some mean diurnal ranges of temperature are given in the accompanying small table:

Diurnal range of temperature (degrees C.) for the seasons.

Station.	Altitude.	Winter.	Spring.	Summer.	Autumn.
	Meters.	° *C.*	° *C.*	° *C.*	° *C.*
Pikes Peak	4,301	4.44	6.22	6.39	6.39
Corona	3,554	6.94	7.94	9.06	8.28
Salida	2,144	15.61	18.50	20.50	18.33
Fraser	2,609	16.87	18.55	20.89	19.17
Denver	1,630	14.06	14.44	15.55	15.55

As may be seen from this exhibit, the diurnal range of temperature is small at the higher stations, and this is the rule the world over. The range is unexpectedly large at Fraser and Salida. The valley at the latter place is open to the southeast, and there is some opportunity for the cold air that descends the mountain sides to drain away.

The data in Table IV were prepared in an attempt to associate excessive cooling at Fraser with the type of weather prevailing at the time. The connection between anticyclonic weather conditions and low night temperatures is unmistakable. The absolute cooling depends somewhat, however, upon the position and movement of the anticyclone. The greatest lowering of temperature evidently occurs when an anticyclone occupies the region to the northwest of Fraser, and stretches in an east-west direction from western Wyoming to southeastern Idaho, with little movement of the center. (See the daily weather maps, Feb. 2–7, 1910.) The converse of the above, viz, little air drainage and reduced nocturnal radiation, occurs with strong winds, cloudiness, and general precipitation, mostly in connection with the movement of an anticyclone southeastward from Montana along the eastern slope of the mountains, at the same time that a cyclone is central west of the mountains and southwest of Fraser. (See the daily weather maps of Feb. 15 and 16, 1910.)

In general, the processes which cause a diminution of nocturnal radiation, and consequently a high night minimum temperature at points situated like Fraser are the same as those which precede precipitation. Evidently they have some prognostic value, and it may be worth while to pursue the matter further.

I desire to express my obligations to Mr. Frederick H. Brandenburg, district forecaster, with headquarters at Denver, Colo., for reading the manuscript of this paper and offering valuable suggestions.

TABLE I.—*Hourly mean temperatures (F.), Corona (3,554 meters) and Fraser (2,609 meters).*

Hours.	January, 1910.		February, 1910.		March, 1910.		April, 1910.		May, 1910.		June, 1910.	
	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1 a. m.	9.0	4.1	3.0	2.9	21.4	20.5	22.6	23.6	27.1	28.0	*40.9*	35.7
2 a. m.	9.0	3.3	2.4	1.9	21.0	19.2	22.1	23.2	26.8	26.8	*40.9*	34.0
3 a. m.	8.6	2.6	2.1	2.9	20.4	17.7	21.5	22.1	26.0	26.1	*40.9*	32.5
4 a. m.	8.8	1.8	1.9	2.6	20.0	16.7	21.2	*21.4*	*25.6*	*24.7*	41.0	*30.6*
5 a. m.	*8.1*	0.7	1.8	2.4	*19.6*	15.7	*20.7*	21.6	26.0	26.1	41.2	32.8
6 a. m.	8.5	0.4	*1.4*	*1.9*	19.8	*15.3*	21.5	24.4	27.1	31.4	42.0	39.8
7 a. m.	9.0	*0.2*	1.6	2.1	20.1	16.3	23.5	28.3	28.6	36.8	44.2	48.0
8 a. m.	10.0	3.1	2.5	5.1	21.4	24.4	25.2	35.1	30.0	42.5	46.1	55.3
9 a. m.	11.0	8.1	3.8	10.0	25.3	31.8	27.1	40.0	32.4	46.6	48.3	61.3
10 a. m.	11.8	13.7	5.0	14.6	25.2	37.9	28.1	42.3	33.7	49.5	49.7	62.7
11 a. m.	12.6	19.1	6.6	19.2	26.8	42.0	29.3	44.0	34.7	51.1	50.5	64.5
Noon	13.3	21.7	7.4	22.4	28.3	44.1	30.1	45.7	35.6	51.2	51.2	**64.8**
1 p. m.	**13.6**	23.2	8.3	23.6	29.3	44.6	30.7	46.4	**36.2**	51.6	50.8	64.1
2 p. m.	13.3	**23.5**	**8.6**	**24.1**	29.8	45.0	**30.9**	**47.2**	**36.2**	**52.1**	**51.3**	64.1
3 p. m.	12.5	22.6	8.4	**24.1**	**30.2**	**45.2**	30.2	46.8	35.9	51.7	49.8	63.9
4 p. m.	11.6	19.3	8.0	22.5	29.9	44.2	29.3	45.6	35.1	50.8	49.0	63.0
5 p. m.	10.5	15.8	6.7	18.4	28.7	42.7	28.3	44.0	34.4	50.1	47.7	62.3
6 p. m.	10.2	12.5	5.4	15.7	26.4	35.7	26.8	40.9	33.5	47.1	48.1	60.6
7 p. m.	10.0	10.7	4.6	13.6	24.4	31.7	25.5	34.9	32.0	41.9	46.4	54.4
8 p. m.	9.9	9.1	4.4	12.4	23.6	29.3	24.9	30.5	30.8	38.5	44.8	48.7
9 p. m.	9.7	7.7	4.4	10.9	23.3	27.3	24.5	28.3	29.7	36.0	43.5	46.8
10 p. m.	9.5	6.4	4.2	9.5	22.6	24.2	24.1	26.6	28.8	33.7	42.9	45.4
11 p. m.	9.6	5.1	3.3	6.7	22.4	23.1	24.0	25.9	28.6	32.0	41.7	40.7
12 night	9.6	3.7	3.1	5.2	22.0	21.0	23.4	25.2	30.2	30.2	41.1	38.1
Mean	10.4	9.9	4.5	11.4	24.2	29.8	25.6	33.9	31.0	39.9	45.6	50.6

Hours.	July, 1910.		August, 1910.		September, 1910.		October, 1910.		November, 1910.		December, 1910.	
	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.	Corona.	Fraser.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1 a. m.	45.6	41.4	*39.1*	38.2	36.0	34.4	26.8	21.0	19.2	25.2	11.8	5.0
2 a. m.	*45.4*	39.8	41.6	36.3	35.4	32.9	26.5	19.9	19.2	24.3	11.6	4.2
3 a. m.	46.2	38.1	42.0	*35.5*	35.9	31.9	26.1	18.9	18.8	23.4	11.3	2.9
4 a. m.	46.5	36.6	42.2	37.2	35.5	30.2	25.7	18.0	18.4	22.8	11.3	2.4
5 a. m.	47.0	*36.3*	42.9	32.8	*35.3*	*29.1*	*25.4*	17.0	18.2	22.5	11.2	1.6
6 a. m.	47.8	42.3	43.7	36.2	35.8	29.7	25.6	*16.5*	*17.5*	21.6	11.1	1.5
7 a. m.	50.5	50.0	45.7	43.8	37.4	34.9	27.1	19.4	18.4	*20.7*	*11.0*	*1.0*
8 a. m.	49.0	56.8	45.5	53.3	40.3	44.0	28.5	28.1	19.0	24.7	11.5	2.8
9 a. m.	52.6	62.9	50.4	59.5	42.1	51.3	30.3	34.8	19.9	30.0	11.7	7.6
10 a. m.	53.4	66.9	50.8	63.6	43.3	57.2	31.7	42.6	21.8	35.2	11.8	13.2
11 a. m.	**53.7**	68.9	**52.3**	67.1	45.5	61.1	33.3	47.6	22.9	39.3	12.7	19.4
Noon	53.5	**69.9**	51.1	68.4	45.6	62.5	34.1	51.1	23.8	41.2	14.1	24.1
1 p. m.	52.6	68.3	49.8	**68.5**	46.1	62.5	**35.3**	**51.9**	24.3	42.3	14.3	26.8
2 p. m.	52.2	67.8	49.4	68.0	**46.4**	**63.2**	34.8	51.5	**24.9**	**42.7**	15.7	27.0
3 p. m.	50.8	67.0	48.3	67.0	45.7	63.1	34.4	51.5	24.2	42.0	**15.8**	**27.2**
4 p. m.	50.8	66.0	49.4	67.8	44.1	61.5	33.0	50.3	22.6	40.3	15.3	24.1
5 p. m.	50.4	64.7	47.4	66.2	43.0	58.5	31.4	45.5	22.1	35.1	15.6	19.2
6 p. m.	50.3	63.2	45.6	62.8	41.9	52.5	30.2	38.6	21.7	31.9	14.7	17.9
7 p. m.	49.2	58.2	43.3	54.2	40.0	47.8	29.2	34.3	20.8	30.2	13.8	15.1
8 p. m.	47.7	53.0	42.9	48.9	38.9	44.7	27.3	31.2	20.6	29.5	12.7	13.2
9 p. m.	46.8	50.4	42.9	47.3	38.1	41.5	27.8	28.4	20.3	27.9	12.0	11.0
10 p. m.	46.1	46.7	41.6	44.8	37.5	38.8	26.9	26.2	20.3	27.2	11.6	8.8
11 p. m.	45.6	46.6	43.2	43.5	36.9	37.2	26.8	25.0	19.2	25.9	11.2	7.0
12 night	47.2	44.0	43.1	40.5	36.4	34.3	26.1	23.2	18.4	25.1	11.6	6.0
Mean	49.2	54.4	45.6	52.1	40.1	46.0	29.3	33.0	20.7	30.5	12.7	12.0

TABLE II.—*Average hourly temperature gradients between Fraser, Colo. (2,609 meters), and Corona, Colo. (3,554 meters), in degrees C. per 100 meters.*

Hours.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Winter.	Summer.
1 a. m.	−0.29	0.00	−0.05	−0.06	0.00	−0.30	−0.25	−0.01	−0.01	−0.34	0.35	−0.40	−0.10	−0.23	−0.19
2 a. m.	−0.36	−0.03	−0.10	−0.06	0.00	−0.41	−0.30	−0.31	−0.15	−0.39	0.19	−0.42	−0.18	−0.27	−0.34
3 a. m.	−0.35	−0.05	−0.16	0.00	0.00	−0.49	−0.48	−0.38	−0.24	−0.43	0.27	−0.59	−0.24	−0.29	−0.45
4 a. m.	−0.41	−0.04	−0.20	0.00	−0.10	−0.61	−0.59	−0.30	−0.31	−0.45	0.26	−0.52	−0.27	−0.30	−0.50
5 a. m.	−0.43	−0.03	−0.23	−0.06	0.00	−0.49	−0.63	−0.60	−0.36	−0.50	0.25	−0.56	−0.30	−0.32	−0.57
6 a. m.	−0.48	−0.03	−0.27	−0.17	0.25	−0.13	−0.32	−0.44	−0.35	−0.54	0.24	−0.56	−0.22	−0.34	−0.29
7 a. m.	−0.52	−0.03	−0.22	0.28	0.83	−0.22	−0.03	−0.11	−0.15	−0.45	0.14	−0.58	−0.10	−0.35	0.03
8 a. m.	−0.41	−0.15	0.20	0.58	0.73	0.54	0.46	0.46	0.22	0.00	0.34	−0.50	0.21	−0.25	0.49
9 a. m.	−0.17	0.36	0.50	0.76	0.83	0.76	0.60	0.53	0.54	0.26	0.59	−0.22	0.44	−0.01	0.63
10 a. m.	−0.11	0.56	0.74	0.83	0.93	0.76	0.89	0.77	0.83	0.64	0.79	0.10	0.64	0.25	0.81
11 a. m.	0.38	0.74	0.89	0.86	0.96	0.82	0.89	0.87	0.92	0.84	0.96	0.41	0.79	0.51	0.86
Noon	0.49	0.88	0.93	0.92	0.91	0.80	0.96	1.01	0.99	1.00	1.02	0.60	0.87	0.75	0.92
1 p. m.	0.57	0.90	0.90	0.92	0.91	0.78	0.92	1.10	0.96	0.98	1.06	0.75	0.90	0.74	0.93
2 p. m.	0.60	0.91	0.89	0.96	0.93	0.75	0.91	1.09	0.99	0.98	1.05	0.67	0.89	0.73	0.96
3 p. m.	0.60	0.98	0.88	0.98	0.93	0.83	0.95	1.10	1.02	1.00	1.05	0.68	0.92	0.75	0.92
4 p. m.	0.45	0.85	0.85	0.96	0.92	0.82	0.89	1.08	1.02	1.02	1.05	0.52	0.87	0.61	0.96
5 p. m.	0.31	0.69	0.82	0.92	0.92	0.86	0.84	1.10	0.62	0.83	0.76	0.21	0.74	0.40	0.93
6 p. m.	0.14	0.61	0.55	0.83	0.80	0.73	0.80	1.01	0.46	0.49	0.60	0.18	0.59	0.31	0.87
7 p. m.	0.04	0.56	0.43	0.55	0.58	0.47	0.53	0.63	0.34	0.30	0.55	0.01	0.42	0.20	0.54
8 p. m.	−0.05	0.47	0.34	0.33	0.51	0.23	0.31	0.35	0.20	0.23	0.52	0.02	0.28	−0.15	0.30
9 p. m.	−0.12	0.38	0.26	0.22	0.37	0.19	0.22	0.26	0.01	0.00	0.45	−0.07	0.18	−0.06	0.22
10 p. m.	−0.18	0.31	0.10	0.15	0.21	0.15	0.35	0.19	0.02	0.00	0.52	−0.17	0.14	−0.01	0.23
11 p. m.	−0.27	0.20	0.04	0.11	0.19	−0.01	0.06	0.02	0.02	−0.01	0.39	−0.25	0.04	−0.10	0.02
12 night.	−0.35	0.12	−0.06	0.11	0.00	−0.18	−0.19	−0.15	−0.17	−0.17	0.39	−0.33	−0.08	−0.19	−0.14
Mean.	−0.03	0.41	0.33	0.48	0.55	0.30	0.33	0.39	0.31	0.22	0.57	−0.04	0.32	0.12	−0.33

TABLE III.—*Decrease in temperature (in degrees C. per 100 meters) between Corona (3,554 meters) and Denver (1,630 meters).*

Hours.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1 a. m.	0.59	0.62	0.61	0.76	0.61	0.52	0.59	0.66	0.60	0.56	0.80	0.49	....
2 a. m.	0.59	0.61	0.60	0.64	0.59	0.53	0.57	0.56	0.48	0.55	0.86	0.50	....
3 a. m.	0.57	0.61	0.58	0.62	0.59	0.42	0.50	0.52	0.54	0.53	0.57	0.51	....
4 a. m.	0.57	0.58	0.58	0.61	0.57	0.40	0.46	0.49	0.52	0.53	0.58	0.49	....
5 a. m.	0.58	0.56	0.57	0.61	0.55	0.37	0.41	0.47	0.51	0.54	0.58	0.48	....
6 a. m.	0.59	0.59	0.55	0.59	0.56	0.41	0.43	0.46	0.50	0.52	0.70	0.50	....
7 a. m.	0.56	0.55	0.53	0.60	0.57	0.49	0.47	0.44	0.47	0.48	0.58	0.49	....
8 a. m.	0.56	0.57	0.62	0.69	0.62	0.58	0.65	0.55	0.51	0.53	0.56	0.47	....
9 a. m.	0.56	0.65	0.74	0.77	0.65	0.65	0.66	0.56	0.58	0.64	0.57	0.54	....
10 a. m.	0.59	0.76	0.84	0.83	0.69	0.71	0.74	0.67	0.67	0.73	0.60	0.57	....
11 a. m.	0.72	0.80	0.92	0.87	0.73	0.76	0.80	0.71	0.72	0.80	0.69	0.77	....
Noon	0.77	0.85	0.94	0.89	0.75	0.79	0.88	0.79	0.78	0.89	0.75	0.82	....
1 p. m.	0.82	0.88	0.94	0.90	0.79	0.86	0.94	0.89	0.81	0.90	0.81	0.85	....
2 p. m.	0.86	0.91	0.97	0.93	0.81	0.84	0.97	0.91	0.84	0.92	0.85	0.84	....
3 p. m.	0.86	0.96	0.97	0.96	0.81	0.84	1.01	0.96	0.85	0.97	0.91	0.85	....
4 p. m.	0.84	0.96	0.95	0.96	0.82	0.91	0.97	0.90	0.87	0.98	0.95	0.84	....
5 p. m.	0.84	0.96	0.96	0.96	0.82	0.93	0.95	0.93	0.87	0.97	0.93	0.76	....
6 p. m.	0.78	0.90	0.99	0.97	0.82	0.87	0.89	0.95	0.85	0.91	0.87	0.73	....
7 p. m.	0.74	0.84	0.94	0.89	0.79	0.81	0.84	0.89	0.79	0.82	0.85	0.68	....
8 p. m.	0.71	0.78	0.87	0.84	0.76	0.74	0.79	0.79	0.74	0.80	0.77	0.65	....
9 p. m.	0.70	0.74	0.80	0.79	0.73	0.69	0.75	0.72	0.71	0.72	0.73	0.62	....
10 p. m.	0.67	0.71	0.74	0.74	0.71	0.64	0.72	0.70	0.65	0.68	0.69	0.58	....
11 p. m.	0.64	0.71	0.68	0.69	0.65	0.63	0.69	0.61	0.63	0.63	0.68	0.57	....
12 night.	0.61	0.67	0.64	0.66	0.63	0.58	0.60	0.57	0.60	0.61	0.66	0.52	....
Denver—Corona	0.68	0.74	0.77	0.78	0.68	0.67	0.72	0.70	0.67	0.72	0.73	0.63	0.707
Pikes Peak—Colorado Springs	0.63	0.57	0.68	0.74	0.72	0.74	0.68	0.66	0.64	0.63	0.61	0.58	0.660
Sonnblick—Kolm-Saigurn[1]	0.49	0.57	0.63	0.73	0.73	0.77	0.72	0.69	0.65	05.7	0.54	0.53	0.633

[1] W. Trabert. Der Tägliche gang der Temperatur und des Sonnenscheins auf dem Sonnblickgipfel. Wien, 1892.

TABLE IV.—*Synchronous temperatures at Fraser and Corona, February and July, 1910.*

[In the column of differences the minus signs indicate that the lower station was colder than the upper one and the absence of signs the contrary.]

Days.	February, 1910.						July, 1910.					
	2 a. m.			Noon.			2 a. m.			Noon.		
	Corona.	Fraser.	Difference.	Corona.	[Fraser.	Difference.	Corona.	Fraser.	Difference.	Corona.	Fraser.	Difference.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1	19	− 4	−23	22	31	9	......	33	......	......	66	......
2	0	17	17	− 5	19	24	......	40	......	......	70	......
3	− 5	−15	−10	12	22	10	......	34	......	......	70	......
4	2	−22	−24	18	20	2	......	36	......	......	71	......
5	13	−24	−37	25	23	− 2	40	35	− 5	43	58	15
6	9	−23	−32	10	24	14	40	35	− 5	51	64	13
7	4	−16	−20	14	26	12	40	47	7	51	66	15
8	4	− 5	− 9	2	19	17	42	31	−11	55	70	15
9	− 3	− 6	− 3	2	20	18	44	35	− 9	54	70	16
10	− 1	−14	−13	3	17	14	38	34	− 4	54	70	16
11	− 1	3	4	1	16	15	39	34	− 5	54	67	13
12	2	14	12	3	17	14	38	43	5	52	63	11
13	9	21	12	16	32	16	38	35	− 3	52	70	18
14	18	19	1	26	41	15	47	33	−14	57	76	19
15	− 7	8	15	− 9	9	18	50	37	−13	63	77	14
16	−18	− 2	16	−15	7	22	46	45	− 1	55	76	11
17	−28	−25	3	−17	1	18	46	49	3	49	74	25
18	−15	− 8	7	− 1	13	14	49	43	6	60	74	14
19	− 4	− 8	− 4	11	19	8	54	42	−12	53	79	26
20	0	13	13	2	19	17	50	45	− 5	47	75	28
21	− 1	− 4	− 3	0	23	23	49	46	− 3	51	70	19
22	8	24	16	14	33	19	47	39	− 8	60	68	8
23	13	24	11	12	29	17	54	39	−15	54	73	19
24	13	22	9	22	39	17	46	35	−11	61	76	15
25	20	23	3	18	35	17	50	36	−14	56	76	20
26	5	18	13	− 1	17	18	52	38	−14	59	77	18
27	3	10	7	9	28	19	52	47	− 5	57	65	8
28	8	13	5	14	35	21	45	49	4	52	56	4
29	......	......	......	......	......	......	43	46	3	46	63	17
30	......	......	......	......	......	......	42	50	8	46	66	20
31	......	......	......	......	......	......	......	......	......	......	......	......
Mean	2.4	0.5	1.9	7.4	22.6	15.2	45.4	40.3	5.1	53.5	69.9	15.4

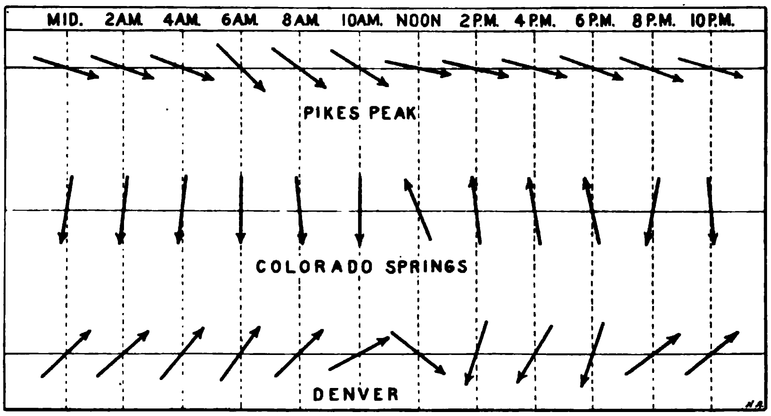


FIG. 1.—Average winds during winter months.

(IX) WAVES OF PRESSURE IN THE ATMOSPHERE RECORDED BY AN INTERFEROMETER BAROGRAPH.

By Albert C. Crehore, Ph. D., and George O. Squier, Ph. D.

[Dated Apr. 18, 1911.]

At the present time there is a special interest in problems relating to the physics of the atmosphere. The realization of dynamic flight has created a demand for new information concerning the atmosphere. A knowledge of the exact state of the atmosphere at the exact time and place of flight is much desired by those whose machines travel at the rate of over 60 miles an hour. The ordinary instruments available for pressure and wind are the various forms of barometer and anemometer, respectively.

The atmosphere is never in a state of rest. Practical aviators say that the aerial path is made up of continual eddies and whirls, bumps and holes, gusts and swirls. Unlike the chauffeur, the aviator can not see his road, but must feel it. His portable aneroid-barograph has come to be his standard instrument for determining his altitude, but its use for this purpose determines the performance of the aviator and his own ups and downs rather than the changes in the state of the atmosphere with respect to the earth. The latter is given by a stationary barograph, but this only shows pressure changes of long period—longer than are particularly useful for the aviator's purpose.

The accompanying figures, 1, 2, and 3, are copies of films giving original photographic records of local pressure changes in the atmosphere during brief intervals of time. Figures 4 and 5 are the graphs of the pressure-time curves deduced from measurements on the original records, figures 2 and 3. Changes taking place from second to second are clearly shown. Intervals of one minute of time are indicated on the photographs by the heavy transverse lines.

The instrument by which these records were obtained is shown in figure 6. The essential part of this is a set of eight standard aneroid cells, A, from which the air is exhausted, such as are used in the Richard barograph. These cells continually expand and contract in conformity with the varying atmospheric pressure. In the common aneroid barometer these expansions and contractions are magnified several hundred fold by a system of mechanical levers. The "lost motion" attending any such combination of levers and pivots in the nature of things obliterates all of the delicate and rapid motions that are present in the cells when they are entirely disconnected from the levers. The indications that the levers show are those grosser changes of pressure taking place slowly in extended intervals of time.

For the purpose of observing and recording the minutest motions of expansion and contraction of these cells the method of the interference of light has been applied. The power of the method is so great that the real motion of the cells is magnified about 50,000 times instead of some hundreds of times as with levers, and at the same time the cells are absolutely free from contact levers which would mask the real motion.

The pile of eight cells is mounted on the brass base, B, having three brass posts extending up to the level of the uppermost cell. To form interference bands a plane glass plate silvered on its upper surface is mounted in a horizontal position on the center of the upper cell so as to form a part of it, and rises and falls as the atmospheric pressure allows the cells to expand or contract. To prevent oscillations of the cells laterally as a whole, they are tied to the three upright posts by silk fibers attached thereto in a horizontal plane, so as not to interfere with the free vertical motion of the system. A second plane glass plate thinly silvered on the underside is supported by three leveling screws bearing on the tops of the three posts. The two plates of glass together form the interference system.

A mercury vapor lamp is used as the source of light and is placed almost directly above the two interference plates. A real image of the bands, caused by the reflection upward of the light from the two horizontal interference plates, is formed on the ground glass of a camera placed with the axis of its lens in a vertical position and the plane of its ground glass in a horizontal position.

In adjusting to produce interference bands a convenient method is to lower the upper plate by the adjusting screws until it rests upon the lower plate. In this position the bands are easily focused on the ground glass. The upper plate is then gradually raised by the adjusting screws, and the bands may thus be kept in the field of view continuously. When the separation of the plates is sufficient to leave the barometer cells free, the bands will appear as circles, and the center of the system of circles may by the adjusting screws be located in any desired part of the field. Since the upper interference plate is supported on the three posts by the frame of the instrument, and the lower plate moves with the cells in a vertical direction, the distance between them for small displacements is changing by an amount proportional to the change of pressure of the atmosphere. As the lower plate rises with an expansion of the cells, caused by a fall in the pressure of the atmosphere, the circular interference bands contract and diminish to a point and disappear one after another.

To obtain a photographic record of the motion of these circular bands upon a uniformly moving film a slit is placed transversely across the film and the real image of the bands focused upon this, so that the center of the system of circles falls approximately upon the slit. The light which passes through this slit falls upon the moving film and forms a series of alternately light and dark bands selected along a diameter of the circles, and as they expand and contract with the atmospheric pressure each band makes its own record upon the film as a wavy or sinuous line. The feeding of the film is accomplished by clockwork at a uniform rate, so that all distances along the film represent time. At regular intervals of one minute all light is shut off from the film for a very brief time, thus marking minute intervals on the record.

Since a change in the distance between the two interference plates of exactly one-half wave length of the particular kind of light used causes a motion of the fringe system of just one band, the expansion and contraction of the barometer is determined from the record by counting the number of bands as they appear and disappear. To illustrate the method, we explain the manner in which the curve in figure 5 is obtained from the photograph, figure 3.

Select any point as an origin for measuring on the photographic film distances which represent time, and with dividers lay off these distances to the points where the bands appear or disappear, as abscissae on the cross-section paper; the number of each successive band becomes its corresponding ordinate. Any whole number may be assigned to the band we start with, because we are concerned with relative and not absolute values of pressure; but each succeeding band takes a number one unit greater or less than its predecessor, as the case may be, unless a maximum or minimum point is passed. In other words, the resulting curve, e. g., figures 4 and 5, not only records the total number of bands passing by, but the times at which they pass. Maximum and minimum points are easily distinguished on the photograph, as each maximum point is surrounded by a number of closed bands of an elliptical shape, and the minimum points are indicated by two bands which approach each other from the sides of the record, forming a sort of a hyperbolic curve.

The general form of the pressure-time curve is shown by those bands toward the margin of the record farthest removed from the center of the system, but the displacements or ordinates of this curve are not exactly proportional to the pressure changes, as is the curve that is obtained by measurements at the center, as above shown.

When the circular bands contract to such an extent that a given circle takes the former position of the circle next smaller, then the interference plates have approached each other by a distance equal to one-half of a wave length of the particular kind of light used. Taking the wave length of the adopted band of the mercury vapor light as 40.47×10^{-6} centimeters, the half wave is 20.23×10^{-6} centimeters. The diameter of the band nearest the center, just as the next band is appearing at the center, is approximately 1 centimeter at the ground glass of the camera, and as this band contracts to zero for a motion of one-half wave length in the cells, the degree of magnification is obtained by dividing 1 centimeter by the half wave length of light, which gives 49,400, or approximately 50,000 times.

The intervals of time between the points corresponding to consecutive bands represent the times required for the cells to deflect just one-half wave length of light, and for small changes this motion is exactly proportional to the changes of atmospheric pressure causing the displacements. Hence, the numeration of the interference bands as ordinates and the distances along the record films as abscissas give a true "pressure-time" curve of atmospheric changes. To convert the ordinates of this curve into barometric pressure only requires that the scale readings of this aneroid barometer be compared with those of a standard mercurial barometer.

It is instructive to watch the expansion and contraction of the circular interference bands as they pass through cycles of changes back and forth, at one time so steady and regular as to show only a few changes of bands within a minute of time, and again so fast that they can not be counted with certainty.

As the cells are free to vibrate they are somewhat sensitive to mechanical jars and vibrations. When the instrument stands on an ordinary bench the passing of a railroad train half a mile distant visibly causes slight oscillations of the bands. These disturbances are, however, easily prevented by properly mounting the instrument. This phenomenon suggests that a similar method may be applied to the study of vibrations of the earth, giving most delicate seismographic records.

The interference method can be applied to the mercurial barometer as well as to the aneroid, and thus increase its sensitivity, but the aneroid seems much more suitable for the purpose when the rapidity of the changes is considered. The volume and mass of the mercury in a mercurial barometer is likely to mask the effect sought to be measured, but the light thin cells of the aneroid seem to be ideal for the purpose. From long observation of the motions of the bands at different times there are found to be periods when they pass so rapidly that it is difficult to count them.

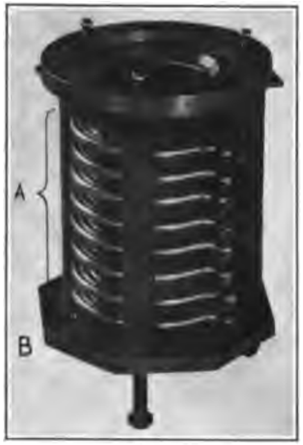
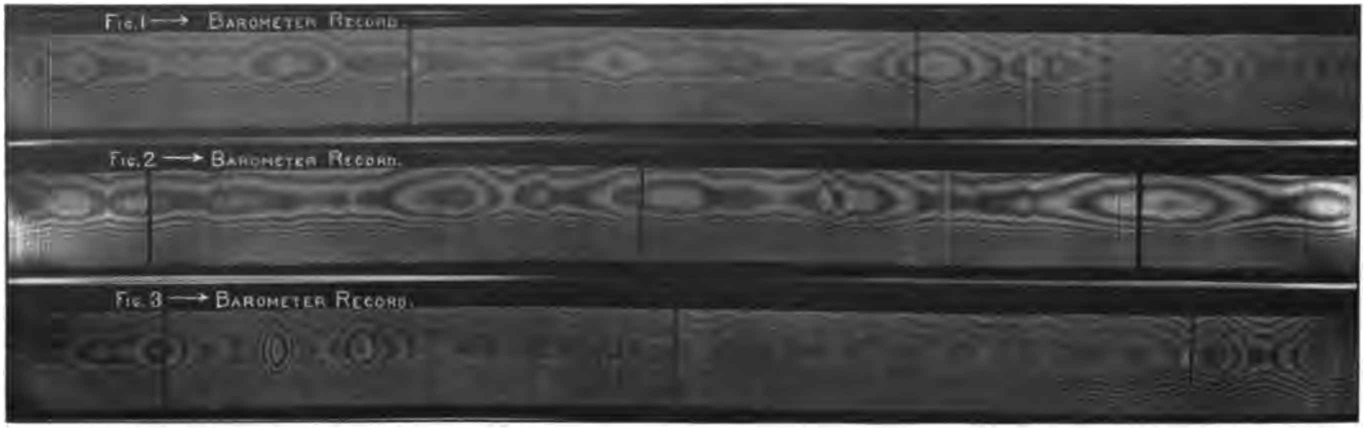
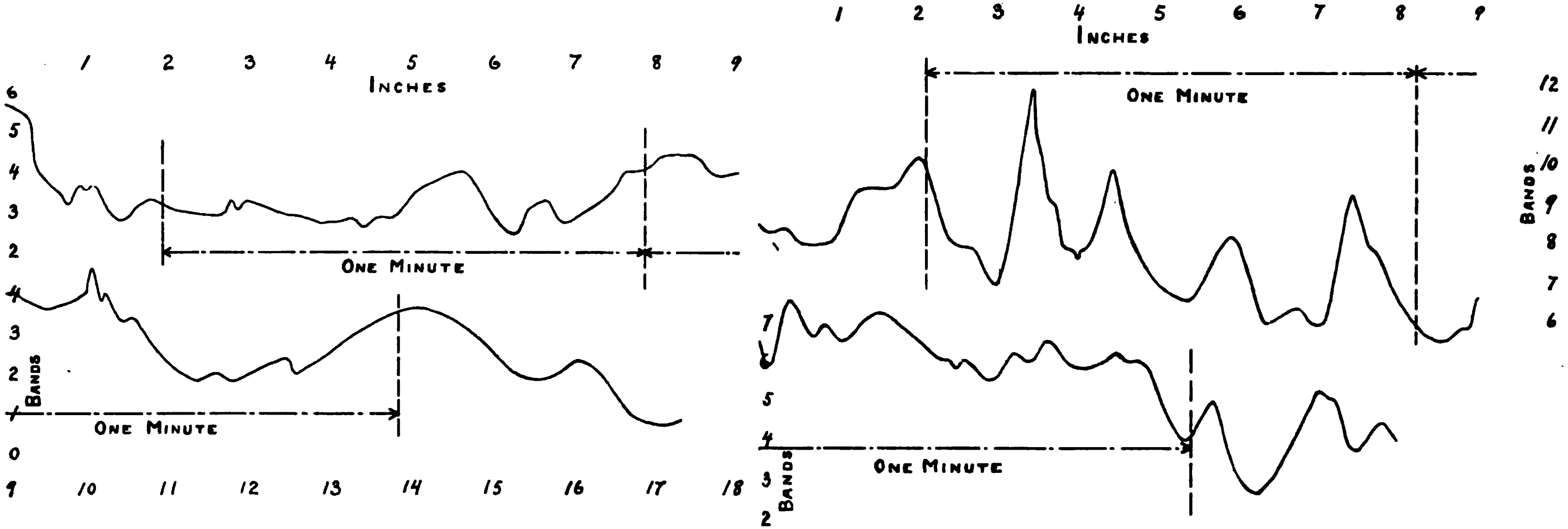


FIG. 6.—EIGHT STANDARD ANEROID CELLS.



FIGS. 1, 2, 3.—FACSIMILE (REDUCED ⅛) OF ORIGINAL PHOTOGRAPHIC RECORDS OF THE INTERFEROMETER BAROGRAPH.



FIGS. 4 AND 5.—GRAPHS OF PRESSURE-TIME CURVES.

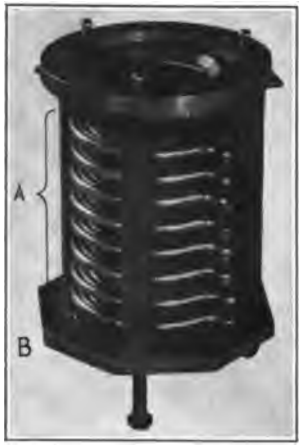


FIG. 6.—EIGHT STANDARD ANEROID CELLS.

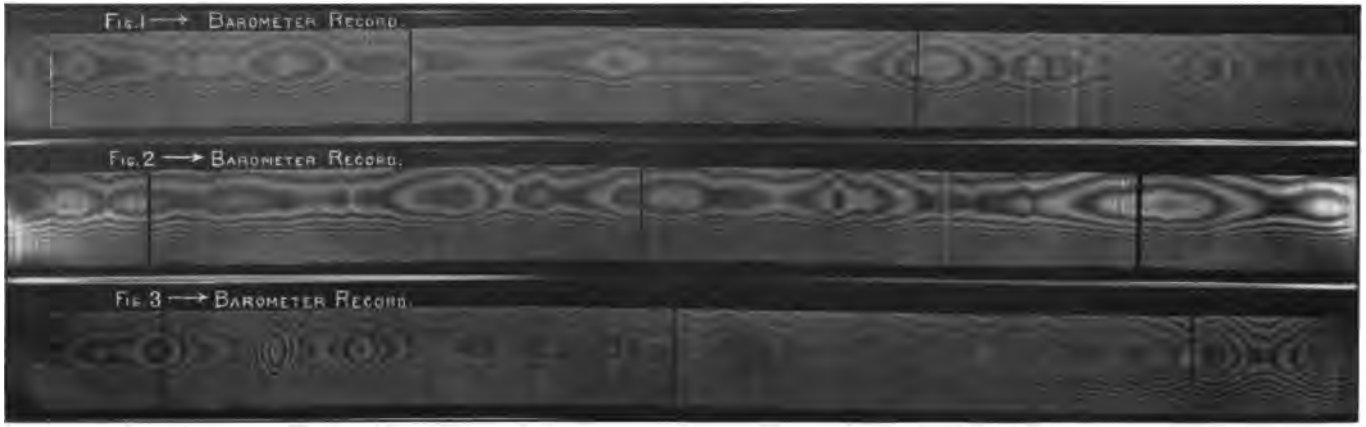
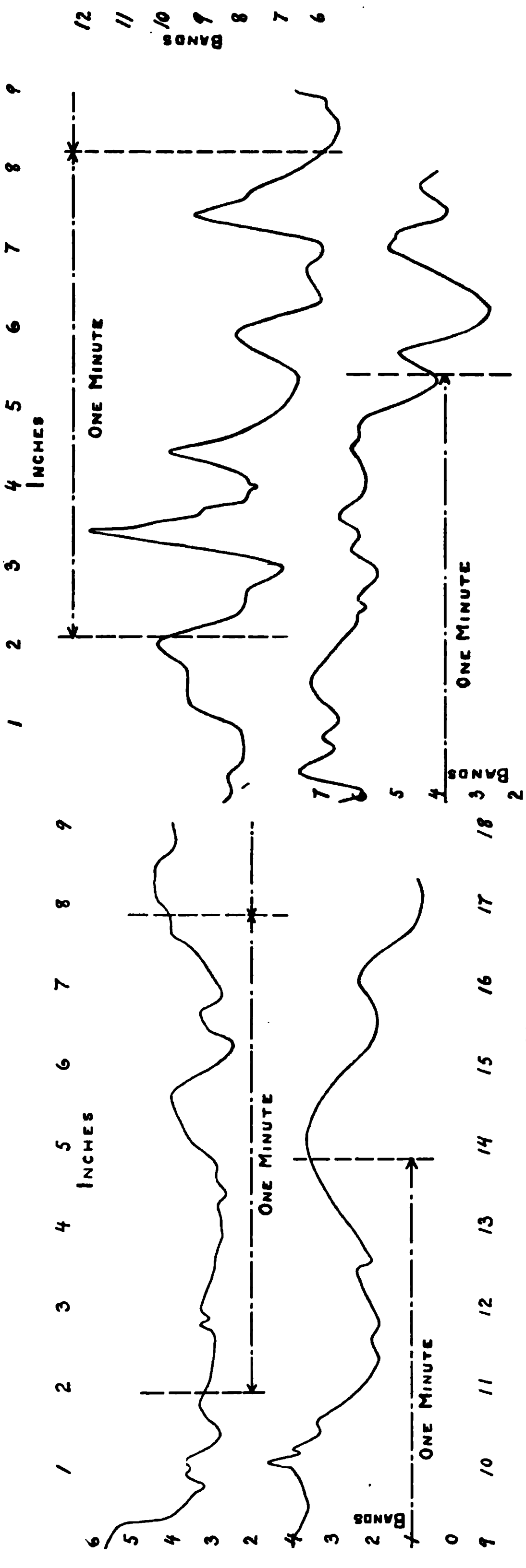


Fig. 1 → Barometer Record.
Fig. 2 → Barometer Record.
Fig. 3 → Barometer Record.

FIGS. 1, 2, 3.—FACSIMILE (REDUCED ½) OF ORIGINAL PHOTOGRAPHIC RECORDS OF THE INTERFEROMETER BAROGRAPH.



FIGS. 4 AND 5.—GRAPHS OF PRESSURE-TIME CURVES.

(X) THE AMOUNT AND VERTICAL DISTRIBUTION OF WATER VAPOR ON CLEAR DAYS.

By W. J. HUMPHREYS.

[Dated July 10, 1911.]

It is of especial importance to anyone using a bolometer or a pyrheliometer to know the approximate amount of water vapor through which the radiation reaching his instrument has passed. For this purpose the value given by Hann [1] is commonly used, though it was obtained from a general average of the moisture distribution on all sorts of days, while that which is actually needed is the average amount of moisture on clear days only, or, best of all, the particular amount through which the solar radiation passed at the given time and place of observation.

Presumably this quantity is capable of direct evaluation by spectroscopic and bolographic methods; but as such methods have not yet been satisfactorily applied to this purpose, and as it may not always be convenient to use them, even should they be devised, it seems desirable to determine as closely as possible, and in some other way, the amounts of water vapor in the atmosphere on distinctly bolometric or exceptionally clear days, and, if possible, to find a relation between these amounts and some easily measurable quantity such that from the values of the latter the corresponding values of the former may at once be computed.

With this object in view, the records of hundreds of balloon flights have been examined, and among them 74 found which were obtained on cloudless days. All these have been used for obtaining the data needed, and these alone, since, as above implied, both the distribution and the amount of moisture in the atmosphere generally are different when the sky is clear from what they are when it is cloudy, and since also the bolometer and the pyrheliometer are seldom used except when the sky is essentially free from all condensation.

The data used in this study pertain to Europe alone, but presumably are fairly representative of conditions everywhere, since they cover the observations of several years and were obtained at many different places. A larger number of observations would, of course, give smoother curves, but the final conclusion probably would not greatly differ from that drawn from the present limited number.

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[1] Lehrbuch der Meteorologie, second edition. p. 171, Leipzig, 1906.

Nevertheless it must be distinctly remembered that the amount and distribution of water vapor in the atmosphere differs more or less from day to day and from place to place, as is evident from Table I, and that therefore, however large the number of observations from which averages might be obtained, such values could apply only approximately to any given case and should be used only when more exact values are unnecessary or unavailable.

Table I gives the date and place of each balloon flight used in this investigation and also the grams of water vapor per cubic meter at the respective elevations. This latter portion of the table, the grams per cubic meter, was computed from the original corresponding records of temperature and relative humidity. The flights commonly were begun about 8 o'clock in the morning. Those of the free balloons generally lasted about two hours; the others several hours longer.

As a matter of convenience, and for whatever it may be worth, the data are grouped according both to season and to the type of balloon, free or manned, used in securing them.

Table II gives the average number of grams of water vapor per cubic meter at different levels, both for the several seasons and for the year. It also gives the total number of observations, using both the manned and the free balloons, from which each average was obtained.

In computing the yearly averages the corresponding spring and fall values were taken once each and the summer and winter values twice and the sum divided by 6. This was because of the corresponding ratio, 1 to 2, of the assumed lengths of the seasons.

All the observations used are recorded in the Veröffentlichungen der Internationalen Kommission für wissenschaftliche Luftschiffahrt. Several other publications were consulted, but no additional usable data were found.

Figure 1 represents Table II in graphical form. It will be noticed that all curves are essentially smooth and similar. The spring and fall curves at an elevation of about 2.5 kilometers, and the summer curve at an elevation of about 3 kilometers, all show a departure from regularity and indicate a tendency to a maximum of humidity.

This tendency to a maximum of humidity occurs just above one of the levels of maximum cloudiness, the cumulus level, and therefore is not in the least a mere accident. To be sure there were no clouds at this or any other level at the times of observation, but of course there recently had been, say, the night or the day before. Obviously, too, they evaporated at this level, and the water vapor they contributed to the atmosphere, though not dense enough to produce a cloud, is made manifest by the readings of the hygrometer and by the local irregularities in the humidity curve.

This is a particularly interesting result and must greatly increase confidence in the general accuracy of at least the relative values of the humidities as recorded by the hair hygrometer.

It will be noticed, too, that the relatively high humidity is at a greater level during the summer than it is in the spring or fall. This is due to the fact that the same seasonal changes take place in the height of the cumulus level of maximum condensation.

The winter curve is markedly affected by the low temperature of the earth, which tends to reduce the humidity near the surface. Any tendency it might show to a maximum humidity should be at a much lower level than that of the summer curve, just as the level of maximum cloudiness is also lower, and such is the case, as is seen in the figure.

The amount of water vapor per unit volume decreases with elevation in an approximate geometric ratio, and the thickness of the water layer that would result from a condensation of all the water vapor in the atmosphere above any given level, whatever the season, so long as cloudless days are used, may be approximately expressed by the equation

$$d = 2\,w,$$

in which d is the depth of the water layer in millimeters and w the weight in grams of the water vapor per cubic meter at the given level or place of observation.

An alternate, and probably equally good expression, is

$$d = 2\,e,$$

in which d, as before, is the depth of the water layer in millimeters and e the partial pressure of the water vapor in millimeters of mercury.

The two expressions are practically identical, and therefore either may be used, because at ordinary air temperatures

$$w = e \text{ nearly}.$$

Hann's average value for all sorts of days is

$$d = 2.3\,e.$$

This is roughly 15 per cent greater than the above value found for clear days, such as are adapted to satisfactory work with the bolometer and pyrheliometer. Hence the amount of water vapor present on such days presumably is less by some 13 per cent than heretofore has been assumed.

TABLE I.—*Grams of water vapor per cubic meter at different levels.*

SPRING (APRIL AND MAY), MANNED BALLOONS.

Date.	Place and elevation.	Kilometers above sea.														
		Surface.	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	11
Apr. 14, 1904	Rome (18 m.)	10.69	7.75	6.03	4.26	3.29	......	......	......	......	......	......	......	......	......	......
Do.	Augsburg (500 m.)	......	6.58	3.69	2.63	2.50	1.90	1.16	......	......	......	......	......	......	......	......
May 5, 1904	Rome (18 m.)	7.01	5.14	4.82	3.29	1.52	1.97	......	......	......	......	......	......	......	......	......
Do.	Vienna (200 m.)	5.10	4.33	3.77	2.28	1.34	......	......	......	......	......	......	......	......	......	......
May 11, 1905	do.	5.96	3.29	2.57	2.92	1.25	2.31	......	......	......	......	......	......	......	......	......
Apr. 3, 1908	Vienna (160 m.)	4.10	......	2.61	1.70	1.00	0.65	0.43	0.28	0.16	......	......	......	......	......	......

SPRING (APRIL AND MAY), FREE BALLOONS.

Date.	Place and elevation.	Surface.	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	11
Apr. 1, 1901	Trappes (170 m.)	4.62	3.73	3.55	2.95	1.98	1.75	0.86	0.40	0.36	0.24	0.06	0.02	0.01	0.01	......
May 4, 1901	Vienna (200 m.)	7.28	......	4.04	3.93	2.88	2.28	1.73	1.21	0.38	......	......	......	......	......	......
Apr. 4, 1905	Strassburg (140 m.)	4.61	4.48	4.25	3.27	2.55	1.94	1.62	0.86	0.36	0.14	......	......	......	......	......
May 11, 1905	do.	7.19	5.56	4.23	4.02	3.92	3.32	2.76	1.64	0.90	0.48	0.26	0.12	0.07	0.04	0.02
Do.	Munich (516 m.)	......	5.86	......	......	2.50	......	......	1.24	0.61	......	0.12	......	......	0.02	0.01
May 2, 1907	Pavia (77 m.)	4.89	6.79	4.53	2.60	1.49	1.00	0.81	0.25	0.10	0.08	0.06	0.04	0.02	0.01	0.02
May 5, 1909	Hamburg (17 m.)	5.93	4.78	3.74	3.53	3.21	2.88	2.54	1.41	0.70	0.36	......	......	......	......	......
Do.	Uccle (100 m.)	4.07	4.02	3.18	2.50	2.05	1.79	1.67	1.27	0.68	0.33	0.15	0.06	0.03	0.02	0.01
May 6, 1909	Strassburg (140 m.)	7.72	5.83	5.10	4.27	3.34	3.76	3.17	1.97	0.84	0.37	0.16	0.06	0.01	0.01	0.01
May 7, 1909	Hamburg (17 m.)	3.48	2.79	2.02	1.77	1.28	0.97	0.87	0.98	0.58	......	......	0.03	0.01	0.01	0.01
Do.	Lindenburg (122 m.)	4.22	3.55	2.83	2.16	1.65	1.34	1.11	0.71	0.40	0.24	0.10	......	......	......	......
Do.	Strassburg (140 m.)	6.08	4.76	3.77	2.70	2.20	1.74	1.49	1.09	0.71	0.37	0.15	0.06	0.02	0.01	0.01
Do.	Trappes (170 m.)	5.04	4.66	......	3.32	2.55	2.08	1.65	1.12	0.60	0.32	0.14	......	......	......	......
Do.	Uccle (100 m.)	4.07	4.02	3.18	2.50	2.05	1.79	1.67	1.27	0.68	0.33	0.15	0.06	0.02	0.01	0.01

SUMMER (JUNE, JULY, AUGUST, AND SEPTEMBER), MANNED BALLOONS.

Aug. 1, 1901	Vienna (200 m.)	14.58	13.84	13.71	9.62	7.15	5.76	5.13	....	....	....	....	....	....	....	....
July 3, 1902	Strassburg (144 m.)	7.46	6.19	4.94	4 19	2.82	0.65	2.37	0.43	....	....	....	....	....	....	....
Sept. 3, 1903	Vienna (200 m.)	7.91	7.46	7.10	3.83	3.01	2.58	1.91	....	....	....	....	....	....	....	....
June 3, 1904	....do	8.64	7.96	6.84	4.24	3.42	....	....	....	....	....	....	....	....	....	....
July 7, 1904	....do	9.36	8.83	7.20	6.53	5.01	....	....	....	....	....	....	....	....	....	....
July 8, 1904	Vienna (160 m.)	14.04	....	9.87	7.12	4.76	3.29	2.80	1.46	0.72	....	....	....	....	....	....
Aug. 4, 1904	Guadalajara (630 m.)	....	5.08	....	3.63	2.52	2.84	3.25	....	....	....	....	....	....	....	....
Do.	Przemysl (50 m.)	8.31	5.89	7.33	6.35	....	....	....	....	....	....	....	....	....	....	....
Sept. 1, 1904	Vienna (160 m.)	9.15	8.85	7.40	4.05	2.88	2.70	2.13	1.12	0.53	....	....	....	....	....	....
Aug. 2, 1906	....do	13.84	10.38	9.52	8.42	6.87	5.06	3.93	2.72	1.41	0.88	....	....	....	....	....
July 5, 1907	Vienna (200 m.)	10.66	9.83	6.75	5.20	....	4.35	3.04	2.02	....	....	....	....	....	....	....
July 23, 1907	Vienna (160 m.)	9.43	....	5.14	4.12	3.53	3.23	2.79	1.61	1.14	0.65	....	....	....	....	....
July 2, 1908	Vienna (200 m.)	7.75	6.50	5.19	4.75	4.60	3.03	3.10	....	....	....	....	....	....	....	....
Do.	Vienna (160 m.)	7.60	....	4.37	4.07	3.59	2.37	2.49	1.41	0.56	....	....	....	....	....	....
July 29, 1909	....do	9.87	....	7.53	5.98	3.48	2.41	2.37	1.40	....	....	....	....	....	....	....

SUMMER (JUNE, JULY, AUGUST, AND SEPTEMBER), FREE BALLOONS.

Aug. 1, 1901	Vienna (200 m)	14.13	....	....	11.43	....	....	7.18	3.04	1.65	0.82	0.56	0.27	0.12	0.08	0.08
Sept. 5, 1901	Trappes (170 m.)	6.49	6.14	5.63	4.87	3.48	2.17	1.31	0.61	0.20	0.11	0.04	0.01	0.01	0.01	....
July 3, 1902	....do	6.94	6.82	6.57	4.52	2.56	1.34	0.70	0.27	0.18	0.12	0.05	....	....	....	....
July 7, 1904	Strassburg (140 m.)	11.50	11.83	10.19	8.46	6.57	5.63	3.93	1.25	1.06	0.57	0.26	0.12	0.06	0.02	0.01
Aug. 5, 1904	....do	13.19	14.42	9.52	6.35	5.32	4.81	3.39	0.94	0.71	0.31	0.14	0.07	....	....	....
June 7, 1906	....do	8.61	6.07	4.07	3.91	2.41	1.07	0.59	0.27	0.19	0.10	0.05	0.02	....	....	....
Do.	Zurich (480 m.)	....	7.00	5.13	4.25	3.02	1.69	0.96	0.49	0.24	0.12	0.07	....	....	....	....
Aug. 2, 1906	Strassburg (140 m.)	15.38	14.47	9.76	6.98	7.14	7.12	5.67	3.09	2.00	0.97	0.44	0.23	0.10	0.06	....
Aug. 2, 1908	Munich (516 m.)	....	9.62	7.65	....	....	4.38	....	....	1.30	....	....	....	....	....	....
July 28, 1908	Zurich (480 m.)	....	11.90	9.90	6.68	5.06	3.97	2.56	2.24	0.61	0.22	0.11	....	....		....
Sept. 30, 1908	Uccle (100 m.)	10.34	8.35	7.60	4.59	3.60	2.05	1.23	0.71	0.39	0.23	0.16	....	....		....
Nov. 7, 1901	Strassburg (144 m.)	4.25	4.51	3.67	0.38	0.37	0.97	1.10	1.46	....	....	....	....	....	....	....
Oct. 1, 1903	Vienna (200 m.)	7.94	8.78	6.73	4.24	2.74	1.99	1.01	....	....	....	....	....	....	....	....
Nov. 5, 1903	Rome (18 m.)	8.50	7.18	6.25	5.85	4.29	2.50	1.05	....	....	....	....	....	....	....	....
Oct. 4, 1906	Vienna (200 m.)	8.01	6.61	5.67	4.73	3.80	1.68	....	....	....	....	....	....	....	....	....
Nov. 6, 1907	Vienna (160 m.)	3.77	....	1.23	1.92	1.27	0.85	0.73	0.41	0.23	....	....	....	....	....	....

TABLE I.—*Grams of water vapor per cubic meter at different levels*—Continued.

FALL (OCTOBER AND NOVEMBER), FREE BALLOONS.

Date.	Place and elevation.	Kilometers above sea.														
		Surface.	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	11
Oct. 3, 1901	Trappes (170 m.)	7.19	7.23	5.39	4.61	3.54	2.79	1.82	0.66	0.21	0.09	0.04	0.01	0.01		
Nov. 7, 1901	....do	4.00	4.85	2.48	1.28	0.71	0.41	0.23								
Oct. 1, 1908	Uccle (100 m.)	10.91	8.36	5.16	3.87	2.10	1.29	0.94	0.58	0.35	0.21	0.11	0.05	0.02	0.01	0.01
Oct. 2, 1908	Hamburg (17 m.)	13.54	11.80	8.88	6.17	5.21	4.39	3.46	2.00	1.15	0.60	0.30	0.14	0.07	0.04	
Do	Munich (516 m.)		6.65				3.46	2.33	1.31	0.59	0.30	0.15	0.08	0.04	0.02	
Do	Strassburg (140 m.)	8.34	6.86	5.11	5.02	4.61	3.73	2.72	1.44	0.76	0.44	0.20		0.05		0.02
Do	Uccle (100 m.)	9.12	6.71	4.68	2.95	2.16	1.59	1.15	0.63	0.41	0.20	0.11	0.05	0.02	0.01	0.01
WINTER (DECEMBER, JANUARY, FEBRUARY, AND MARCH), MANNED BALLOONS.																
Jan. 10, 1901	Berlin (40 m.)	2.43	1.52	1.05	1.00											
Do	Przemysl (200 m.)	1.58	2.18	1.52	1.18	0.94	0.75	0.63								
Jan. 9, 1902	Vienna (200 m.)	3.88	3.60	3.00	1.96	1.14	0.79	0.63	0.32							
Feb. 1, 1906	Guadalajara (630 m.)		2.99		2.09	1.76	1.75	1.32								
Jan. 3, 1908	Vienna (200 m.)			0.79	0.59	0.46	0.33	0.27								
Jan. 13, 1909	....do	2.59	2.53	1.78	1.05	0.73	0.42	0.27								
WINTER (DECEMBER, JANUARY, FEBRUARY, AND MARCH), FREE BALLOONS.																
Dec. 5, 1901	Trappes (170 m.)	4.29	4.35	3.57	1.66	0.76	0.42	0.35	0.11							
Do	....do	3.48	3.33	2.42	1.25	0.73	0.44	0.31	0.11							
Mar. 2, 1902	....do	5.02	5.78	4.80	2.76	1.28	0.77	0.54	0.19	0.06	0.03	0.01				
Feb. 9, 1905	Strassburg (140 m.)	5.00	4.15	3.23	2.66	1.89	1.36	1.07	0.58	0.28	0.14	0.04	0.03	0.01	0.01	0.01
Feb. 1, 1906	....do	3.79	2.36	1.49	1.11	0.84	0.70	0.66	0.48	0.28	0.18	0.09	0.05	0.02	0.02	0.02
Feb. 8, 1907	....do	3.22	2.70	3.34	2.41	1.86	1.36	1.05	0.56	0.23	0.10	0.05				
Feb. 6, 1908	....do	2.62	3.05	2.40	1.73	0.72		0.74	0.63	0.39	0.20	0.09	0.06	0.03	0.02	0.02
Jan. 3, 1908	Trappes (170 m.)	1.42	1.24	2.39	2.14	1.49	0.97	0.65	0.21	0.14	0.07	0.04	0.02	0.02	0.02	0.02
Jan. 4, 1908	....do	1.59	1.61	3.59	3.42	2.23	1.52	1.00	0.45	0.23	0.14	0.07	0.03	0.02	0.02	0.02
Jan. 3, 1908	Uccle (100 m.)	1.14	1.20	1.25	1.12	1.08	1.08	0.89	0.41	0.21	0.10	0.06	0.03	0.02	0.02	0.02

TABLE II.—*Number of observations and grams of water vapor per cubic meter at different levels.*

Seasons.	Kilometers above sea.																
	Surface.	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	11	12	13
Spring	18 5.67	18 4.89	19 3.83	19 2.98	20 2.23	17 1.97	15 1.57	15 1.05	15 0.53	11 0.29	10 0.14	8 0.06	8 0.02	9 0.02	8 0.01	7 0.01	7 0.01
Summer	22 10.23	21 9.36	24 7.45	25 5.76	22 4.22	22 3.29	22 2.77	18 1.40	16 0.80	12 0.43	10 0.19	6 0.12	4 0.07	4 0.04	2 0.04	....	....
Fall	11 7.78	11 7.23	11 5.02	11 3.73	11 2.62	12 2.15	11 1.50	8 1.06	7 0.53	6 0.31	6 0.15	5 0.07	6 0.04	3 0.02	3 0.01	2 0.01	....
Winter	14 3.01	15 2.84	15 2.44	16 1.76	15 1.20	14 0.91	15 0.69	11 0.37	8 0.23	8 0.12	8 0.06	6 0.04	6 0.02	6 0.02	6 0.02	3 0.01	3 0.01
Year	65 6.66	65 6.09	69 4.77	71 3.63	68 2.62	65 2.09	63 1.67	52 0.94	46 0.52	37 0.28	34 0.13	25 0.06	24 0.04	23 0.03	19 0.02	12 0.01	10 0.01

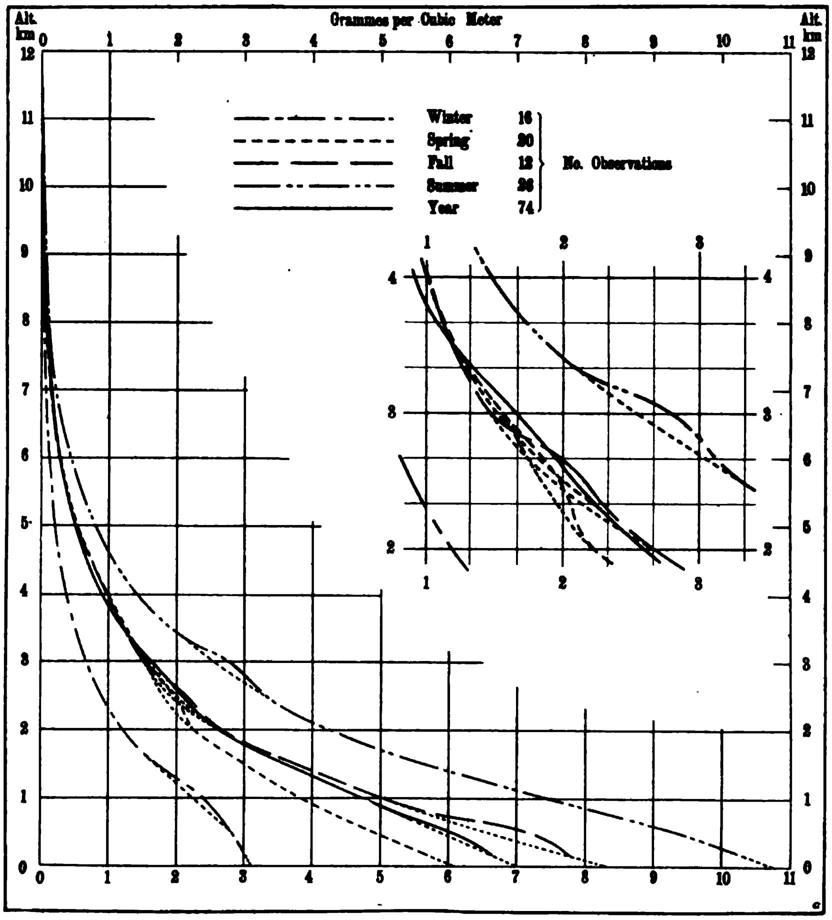

FIG. 1.—Vertical distribution of water vapor on clear days.

(XI) THE EARTH'S RADIATION ZONES.

By W. J. Humphreys.

[Dated July 25, 1911.]

Obviously, since our climates are not now perceptibly growing either colder or warmer, the total amount of heat received by the earth during the course of a year (approximately all from the sun) is substantially equal to its loss through radiation during the same time. This equality of gain and loss, however, does not apply in detail. In general it is not true for a limited portion of the earth for either long or short periods, nor for the entire earth for any period other than a whole year or whole multiples of a year; and even this, as above implied, is only approximately correct, for it is based on the slightly inaccurate assumption that the output of solar energy is constant both in quantity and quality.[1]

Changes in the solar distance, in the relative lengths of day and night, and in the angle of inselation all profoundly modify the amount of energy received at any given place and prevent short period equalities between thermal gain and loss.

The rate of gain is exceedingly variable, and ranges from zero at all places where the sun is below the horizon, neglecting twilight diffusion, to an absolute maximum of about 2 calories per minute per square centimeter wherever the sun is in the zenith at the time of perihelion. In this connection it may be interesting to note that the absolute maximum 24-hour gain, while also at the time of perihelion, is not on the southern Tropic, as is the absolute instantaneous maximum, but at the South Pole.

On the other hand, the rate of energy loss through radiation is far more regular everywhere and at all times than is the gain, due to the storage of sensible heat in the soil, air, and water, and its gradual but continual emission, and also because of the latent heat of fusion and evaporation, taken up at certain places and later, through the operations of convection, given out at others. Of these the chief equalizer of temperature is the process of evaporation and condensation. Indeed the amount of heat used in producing evaporation, without change of temperature, at the surface of land and water, and later by condensation, set free among the clouds as sensible heat, is surprisingly great. Thus a rainfall at a given place of 3 centimeters represents the transfer to that place from others, or to the atmosphere above it, of the heat equivalent of two full days of tropical insolation over an equal area at the limit of the atmosphere, or, because of general atmospheric absorption and the albedo of clouds, from three to four days of surface insolation over an equal area of a tropical ocean.

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[1] That even the quality or spectrum distribution of solar radiation probably affects the temperature of the earth, see Astrophysical Journal, 32, 97, 1910.

Hence if three-fourths (probably an under estimate) of the precipitation over the United States east of the Rocky Mountains, roughly 66 centimeters, is due to evaporation from the Gulf of Mexico and from the warmer portions of the Atlantic Ocean, it follows, assuming equal areas, that all the heat of about 75 days received at the water surface is there rendered latent and subsequently given out as sensible heat in the atmosphere of higher latitudes. Hence a considerable amount of heat received at warmer parts of the earth is there entrapped and carried to colder for liberation and radiation to space.

Another important factor in the reception of solar and the emission of terrestrial radiation is the height, nature, and distribution of clouds. This follows from the fact that, as pointed out by Abbot and Fowle,[1] owing to the large coefficient of absorption that water vapor has for long wave-length radiation, the effective radiating surface of the earth has an average elevation of fully 4 kilometers. Low lying clouds, such as prevail in high latitudes, are below this level, and therefore but slightly affect the outgoing radiation. On the other hand, very high clouds, so common within the Tropics, are above this radiating level, and hence are in position greatly to decrease the amount of earth radiation that directly escapes to space. In fact, in proportion to their continuity, they afford a secondary but colder and hence much less effective radiating surface. Low clouds, when existing alone, allow some heating of the upper portion of the radiating region by direct and reflected insolation. On the other hand, high clouds, except in so far as they let solar radiation through, prevent any such heating of the lower atmosphere.

During the formation of a cloud at any level, heat of course is given out in proportion to the amount of condensation. But after its formation a mere floating cloud below the effective radiating level is like unto a buried rock, in that the temperature of the rock but slightly affects the radiation and surface temperature of the soil above. The high cloud, on the contrary, is somewhat like unto a tent which, being above the surface and not beneath it, is in position to arrest the surface radiation. In short the low cloud is within the earth, counted as a radiator, and the high cirrus cloud without. Hence the latter and it alone can greatly check the flow of outgoing radiation. And it must greatly check this flow since a layer of water, and presumably of ice, 0.1 millimeter thick is almost wholly opaque to radiation of greater wave length than 2μ.[2]

Now, the highest cloud, the cirrus, is more common during the warmer than during the cooler portions of the day, and more frequent during summer and fall than at other times of the year. Hence one would infer, as does Hann,[3] that it must decrease in frequency and extent from the equator toward the poles. This inference is supported by van Bemmelen's[1] statement that at Batavia there is almost always a cirrus veil at an elevation of about 11 kilometers. It is also strongly supported by the monthly reports of cloud observations taken at various places in the Philippines,[2] which show that cirrus in some form is of almost daily occurrence in those regions, and by similar observations elsewhere in the Tropics. No such frequent occurrence of these clouds obtains in middle and high latitudes. Hence it seems safe to assume that Hann's inference is entirely correct.

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[1] Annals of the Astrophysical Observatory of the Smithsonian Institution, 2, 173, 1908.

[2] Coblentz, Phys. Rev., 30, 322, 1910.

[3] Lehrbuch der Meteorologie, p. 214, 1906.

The cirrus must reflect a considerable proportion of the solar radiation—the albedo of thick clouds being about 0.7—and presumably also a large amount of earth radiation, though for these long wave lengths the approximate value is not known. It is known, however, that water, and hence thin clouds, transmit short wave-length radiation better than long. Presumably, therefore, the cirrus lets solar radiation in better than it lets earth radiation out.

If the cirrus were a perfect reflector and a nonconductor, the air above it, assuming no insolation, would cool to the temperature it would have in interstellar space, while the temperature below it would approach that of the effective radiating surface. But the cirrus is neither a perfect reflector nor all the time in position, and therefore the above limiting conditions can not be closely approached. However, the cirrus is always outside the radiating earth, and therefore no matter how irregular nor how imperfect a screen it may be the temperature of the high atmosphere must fall to some extent, while that of the lower air, between the cirrus and the radiating layer, must rise, and hence the interzonal or planetary circulation be correspondingly increased.

Let R be the intensity of the outgoing radiation, or total radiation per second per unit area of the effective surface, R_a the fraction of this absorbed and reradiated by the cirrus layer, R_r the fraction reflected, and R_t the fraction transmitted.

Then

$$R = R_a + R_r + R_t.$$

Also if R_i is the intensity of the return radiation, and R_o the intensity of the outgoing radiation above the cirrus, then, approximately, or neglecting temperature changes,

$$R_i = R_r + \tfrac{1}{2} R_a$$

and

$$R_o = R_t + \tfrac{1}{2} R_a$$

Hence when there are cirrus clouds the air above them, because it receives only the decreased amount of radiation, $R - R_i$, must cool to a lower temperature, while the air immediately below them, subject to the increased radiation, $R+R_1$, must reach a higher temperature—the gain of heat must be greater than its loss by radiation.

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[1] Met. Zeit. 28, 213, 1911.

[2] Monthly Bulletin, Philippine Weather Bureau.

Indeed, the mere fact that there is a vigorous circulation of the atmosphere from equatorial to polar regions and return shows that within the Tropics, where cirrus clouds are abundant, the amount of thermal energy gained is greater than that directly lost to space, and that consequently in higher latitudes the amount gained is less than the amount directly lost.

We might, therefore, from the foregoing considerations, expect to find the earth in respect to the intensity of its outgoing radiation roughly divided into zones, with many semipermanent and numerous fleeting irregularities, due to seasonal changes, to precipitation, to extent and height of clouds, and to other disturbing factors.

To explore and map the earth as a radiator it is necessary to obtain temperature records above the level of vertical convection currents and where radiation alone is the temperature-controlling factor. But the well-known isothermal region supplies exactly these conditions. In it there is no appreciable vertical convection, since at any given time and place its temperature varies but little with change of altitude. Besides conduction must be even less effective here than it is in denser portions of the atmosphere, and therefore the average temperature of this region must be essentially due to radiation alone.

Let R be the intensity of the outgoing radiation above the upper limit of vertical convection, T_1 the absolute temperature of the effective radiating surface, aR the fraction of R absorbed and, of course, neglecting temperature changes, reradiated by the upper air and T_2 the resulting absolute temperature of the upper air.

Then, since T_1 applies to a full radiator,

$$R=cT_1^4, \quad aR=kT_2^m$$

and

$$T_2=\left(\frac{ac}{k}T_1^4\right)^{\frac{1}{m}}=bT_1^{\frac{4}{m}}$$

in which c is the constant of the effective radiating surface; k and m the radiation constant and temperature exponent of the upper air.

There are reasons for thinking that the numerical value of m is not very different from 4, but its exact value is not essential to the present study.

Suppose the upper air to have the same conditions above it that actually exist below it. It would then receive just twice the radiation to which it is actually subjected, and at the same time be inclosed between two practically infinite black surfaces each at the temperature T_1. Hence the inclosed gas would also come to the temperature T_1 while its coefficient of absorption, its constant of radiation, and temperature exponent probably would remain essentially unchanged

Presumably then

$$2aR = kT_1^m, \text{ approximately;}$$

but

$$aR = kT_2^m,$$

and therefore, to the same degree of probability,

$$T_1 = \sqrt[m]{2}\, T_2.$$

Hence the several temperatures of the effective radiating surface are to each other as the corresponding temperatures of the superincumbent isothermal region. In short, the T_1 s are to each other as the corresponding T_2 s.

If, therefore, we measure the temperature T_2 of the upper atmosphere above the limit of vertical convection, or in the isothermal region, at various places, we seem to have at once sufficient data for dividing the earth into regions of greater or less planetary radiation, and for obtaining the ratios between their effective temperatures and between the intensities of their radiation. Thus, as explained above, the effective absolute temperatures presumably are to each other as the absolute temperatures of the corresponding isothermal regions, and the radiation intensities to each other as the fourth powers of the temperature ratios.

The average temperature of the isothermal region has not been determined in a sufficient number of places to enable one to divide the earth, as a radiator, into small sections of equal intensity. However, enough measurements of its temperature have been made to show conclusively that the earth has radiation zones of unequal intensity. In a measure, these are counterparts of its climatic or insolation zones, in that, as a radiator, the equatorial zone is the least effective, due presumably to the prevalence of cirrus clouds that partially shield the upper atmosphere from the planetary radiation and at the same time through increase of the temperature below them accelerate the movement of the lower atmosphere to higher latitudes where the cirrus is less prevalent and hence radiation to space freer and more direct.

The existing published data in regard to the temperature of the isothermal region at different latitudes is given in Table I, and the sources of information in Table II.

Figure 1 represents the radiation belts. The distance of the outer curve from the center is everywhere proportional to the corresponding radiation intensities, in so far as these can be interpolated from their relative values as observed (and numerically indicated) at various given latitudes.

The temperature of the isothermal region has not been determined at latitudes higher than 68°, and therefore the radiation-intensity curve near the poles is broken to show that its position merely indicates a plausible, but not definitely known decrease of radiation, as the pole is closely approached. Neither has the temperature of the isothermal region been measured at various southern latitudes; nevertheless, the intensity curve of the northern hemisphere has been duplicated in the southern, because there is no reason to expect this meteorological condition, more than any other, to be essentially different in the two hemispheres.

It has been shown by Abbot and Fowle[1] that, assuming the solar constant to be 2.1, the planetary radiation of the earth averages about 0.33 gram calories per square centimeter per minute. Later determinations by the same authors[2] indicate a lower average value, 1.922, of the solar constant, and presumably, therefore, the estimated value of the earth's radiation should be correspondingly reduced.

Knowing the relative intensities, the corresponding areas, and the average intensity over the entire earth, it is easy to compute the zonal intensities. This has been done, and the values are given in Table III.

TABLE I.—*Relations of isothermal region to latitude.*

	1	2	3	4	5	6	7	8	9	10	11
General condition of weather	Very rainy.	Rainy.	Serene.	Fair.	Fair.	Fair.	Mixed.	Mixed.	Mixed.	Mixed.	(?)
Height of isothermal region km	17.5	16.3	15	14	12.8	12.6	12.5	12	10.6	9.6	9.5
Temperature of isothermal region	−80° C.	−73° C.	−67° C.	−65° C.	−59° C.	−57° C.	−57° C.	−56° C.	−56° C.	−55° C.	−60° C.
Surface temperature	24° C.	24° C.	24° C.	24° C.	27° C.	24° C.	17° C.	19° C.	10° C.	5° C.	− 9° C.
Relative radiation intensities	61	71	80	83	93	96	96	98	98	100	91
Number of observations	3	3	3	1	2	7	22	9	294	28	(?)
Latitude	6° S.	6° S.	1° S.	19° N.	26° N.	34° N.	38° N.	40° N.	49° N.	60° N.	68° N.

TABLE II.—*Sources of data in Table I.*

	Where obtained.	By whom reported.
Columns 1 and 2	Batavia	W. van Bemmelen.[3]
Column 3	Schirati, Lake Victoria Nyanza	Arthur Berson.[4]
Columns 4, 5, and 6	Atlantic Ocean	L. Teisserenc de Bort[5] and A. Lawrence Rotch.
Column 7	St. Louis, Mo	A. Lawrence Rotch.[6]
Column 8	Indianapolis, Ind., and Omaha, Nebr.	W. R. Blair.[7]
Column 9	Europe	Arthur Wagner.[8]
Column 10	Pavlovsk	E. Gold and W. A. Harwood.[9]
Column 11	Kiruna, Sweden	L. Teisserenc de Bort.[10]

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[1] Annals of the Astrophysical Observatory of the Smithsonian Institution, 2, 164, 1908.

[2] Abbot, Proceedings Amer. Phil. Soc., 50, 243, 1911.

[3] Met. Zeit., 28, 209, 1911.

[4] Bericht über die aerologische expedition des königlichen aeronautischen observatoriums nach Ostafrika im jahr 1908. Braunschweig, 1910.

[5] Etudes de l'atmosphere marine par sondages aériens. Paris, 1909.

[6] Annals Harvard College Observatory, 68, part 1.

[7] Bulletin of the Mt. Weather Observatory, 3, 127, 1910.

[8] Beiträge zur physik der freien atmosphäre, 3, 57, 1909.

[9] Nature, 82, 49, 1909.

[10] C. R., 145, 149, 1907.

TABLE III.—*Zonal intensities of the Earth's planetary radiation (gram calories per square centimeter per minute) at different latitudes.*

0°-10°	10°-20°	20°-30°	30°-65°	65°-70°	70°-90°
0.26	0.27	0.31	0.34	0.31	0.27

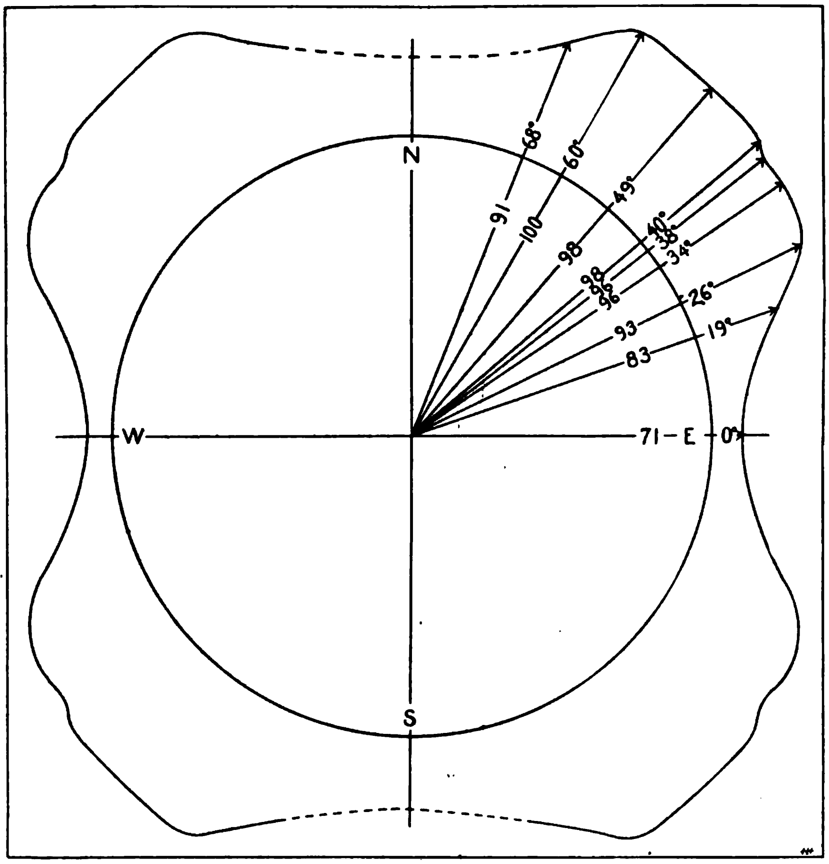

FIG. 1.—Relative intensities of the Earth's planetary radiation at different latitudes.

XII. THE HEIGHT AND TEMPERATURE OF THE ISOTHERMAL REGION AT DIFFERENT LATITUDES AND UNDER DIFFERENT CONDITIONS.

By W. J. Humphreys.

[Dated Aug. 5, 1911.]

It is now generally accepted that the temperature of the isothermal region and the height at which it begins are determined essentially by the amount of outgoing radiation from the clouds and water vapor of the lower atmosphere. However, owing to the large coefficient of absorption that water in all its forms has for radiation of long wave lengths, it is evident that the planetary radiation of the earth, to which the isothermal condition is due, originates at a greater or less average altitude in the atmosphere and, at any given altitude, is more or less vigorous according to the amount, distribution, and condition of cloud and water vapor.

Let T_1 be the effective absolute temperature of the water vapor, on the approximately correct assumption that it is a full radiator for long wave lengths, or the absolute temperature of an equivalently radiating black surface; R the amount of energy radiated outward per second by a unit area of this surface; and T_2 the resulting absolute temperature of the isothermal region—

Then,

$$\mathrm{R}=cT_1^n,\ \ aR=kT^m$$

and

$$T_2=\left(\frac{ac}{k}\mathrm{T}_1^n\right)^{\frac{1}{m}}=bT_1^{\frac{n}{m}}$$

in which c is the constant and n the temperature exponent of the effective radiating surface; k and m the corresponding constant and temperature exponent respectively of the atmosphere in the isothermal region; and aR the fraction of R absorbed and, of course, reradiated by the upper air.

The numerical value of n, since it applies to a black surface, is 4, and if the same value applies also to m it can be shown [1] that

$$T_2=0.84\ T_1,\ \text{approximately}. \qquad (1)$$

But this theoretical temperature relation is in close agreement with that observed many times and at many places in extratropical regions and presumably therefore is essentially correct.

If the above temperature relation is approximately right, then, since T_1-T_2, or the cooling with altitude, $=0.16\ T_1$, the height, H_i, of the under surface of the isothermal region is given with equal accuracy by the equation

$$H_i=H_{\mathrm{T}_1}+0.16\,T_1h,$$

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[1] Astrophysical Jour. vol. 29, p. 14, 1909; this bulletin, vol. 2, p. 1, 1909.

in which H_{T_1} is the height at which the absolute temperature is T_1, and h the average difference in level, above this point, corresponding to a change in temperature of 1° C. As a rule $h = 125$ meters, roughly, and therefore the approximate height in meters is given by the equation

$$H_i = H_{T_1} + 20T_1. \tag{2}$$

From the equations 1 and 2 it is evident that, other things remaining equal, an increase in the planetary radiation, since that means an increase in T_1, necessitates a corresponding increase in both the height and the temperature of the isothermal region.

This special condition, a change in T_1 without any great difference in H_{T_1}, applies roughly to the seasons of temperate regions, since the average summer and winter temperature gradients of the same place are approximately parallel to each other throughout their course, and the isothermal region both higher and warmer during the summer and fall than at other seasons.[1] But, as already stated, this condition applies only roughly. In fact the effective temperature T_1 generally occurs about half a kilometer higher in summer than in winter, due doubtless to the greater amount and average elevation of water vapor during warm than during cold weather.

In general, however, changes in the planetary radiation are accompanied by other and marked changes in the lower atmosphere, and therefore the height and temperature of the isothermal region commonly are due to the combined effects of two or more causes. Among these varying conditions is the change of temperature with altitude, or the vertical temperature gradient, which in turn depends upon the amount, distribution, and condition of the humidity, and upon the speed and direction, both horizontal and vertical, of the wind at different levels, and is, therefore, different not only in different types of storms but also in the several quadrants of the same storm. Another important varying condition results from the fact that latent heat, taken up slowly by evaporation at other places, becomes rapidly evolved sensible heat in the regions of condensation, and in proportion to its amount.

This extra supply of terrestrial radiation increases for the time being the value of T_1, or the temperature of the equivalently radiating black surface, and therefore also affects the isothermal region, both by increasing its temperature T_2, and by bringing its undersurface to a lower level. Thus an increase in the value of T_1 to the extent of 1.2° C., as a result of condensation at middle altitudes, tends to increase T_2 by 1° C. and to lower the under surface of the isothermal region about 125 meters; and in like proportions for other amounts. Generally, however, the change in T_1 is of too brief duration to produce these limiting effects, though often they seem to be more or less closely approached.

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[1] This bulletin, 2, 183, 1910.

When T_1 is altered through a change in the amount of insolation, rather than by mid-air condensation, the entire temperature gradient, from the surface up, is shifted into that of its corresponding season; and, because the effect on H_{T_1} is different, so also is the effect on H_t, as already explained. The seasonal shift of the entire gradient in the same direction is radically different from the storm shifts (commonly of different sense at different levels), and hence their effects on the height and temperature of the isothermal region are not the same.

All the foregoing constitutes only a more or less condensed outline of the generally accepted theory of the isothermal region—a theory that has already accounted in a general way for all but one of its more prominent phenomena.

This outstanding difficulty is the relation of the height and temperature of the isothermal region to latitude, and in particular the fact that the coldest known portion of the isothermal region is near the equator.

The average temperatures of this region at different latitudes are given in Table I, and the sources of information in Table II. The designation "Fair" for the type of weather in columns 4, 5, and 6 is only an inference, presumably correct, from the humidity data.

Table I shows the puzzling relation between latitude, height, and temperature of the isothermal region. According to the simple radiation theory, one would expect difference in latitude to be quite analogous in its effects on the isothermal region to difference in season. But instead of this region growing higher and *warmer* with decrease of latitude, as it does with approach of summer, it grows higher and *colder*.

It has been suggested by the author[1] that possibly the amount of ozone in the upper atmosphere may increase with increase of latitude, due largely to the increase of electrical (auroral) discharges, and that therefore the coefficient of absorption of earth radiation in the upper atmosphere might correspondingly change, and thus give rise to the existing latitude differences in the temperature of the isothermal region. To be sure, the greater absorption coefficient of the ozone also implies a greater radiation coefficient, but not necessarily the same temperature exponent, and hence the final or equilibrium temperatures need not be the same. To make this clear, let R be the intensity of the incident radiation, k and c the absorption coefficients of ordinary and of ozonized air respectively, e_1 and e_2 their emission coefficients, T_1 and T_2 their final absolute temperatures, and n and m the temperature exponents. Then

$$kR = e_1 T_1^n, \text{ and } cR = e_2 T_2^m.$$

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[1] This bulletin, 2, 292, 1910.

But c is decidedly greater than k, and presumably therefore e_2 is of the same order greater than e_1, or $\frac{k}{e_1} = \frac{c}{e_2}$, approximately. If this is an exact equation we get

$$T_2 = T_1^{\frac{n}{m}}$$

Now, in the case of full radiators the temperature exponent is 4, and in the case of other objects generally, if not always, larger. Hence, as m applies to a better absorber than does n it seems probable that n is the greater of the two, and therefore T_2 greater than T_1. At any rate, ozone may be a contributing cause of the observed latitude effects.

However, recent observations within the Tropics suggest an entirely different cause of the phenomena in question. This is the different distribution of humidity and especially of clouds at different latitudes. It neither denies nor affirms an ozone effect, and while it may not alone be sufficient to produce the observed latitude differences in altitude and temperature of the isothermal region, it presumably is an active contributing cause—probably the chief or essential cause of these phenomena.

It is well known that in general the atmosphere of tropical regions is very humid and that any given amount of humidity reaches greater altitudes there than in other parts of the world. Hence the height of the average radiation level is greater there than elsewhere. This is because the large coefficient of absorption that water vapor has for long wave lengths limits the amount of the vapor through which such radiation can directly pass.

But these conditions alone, the increase of water vapor and the greater elevation of the radiation level, are analogous to those of summer in middle latitudes, and therefore while raising the level of the isothermal region should also increase its temperature and not decrease it. Hence, alone they not only fail to account for the actual temperature changes with latitude of the isothermal region, but demand exactly the opposite of those given by observation. Presumably, however, there is another and very important difference between sky conditions of tropical and temperate latitudes to be considered in this connection, namely, *the amount and frequency of high cirrus.*

It is well known that this type of cloud is more frequent and more extensive during the warmer than during the cooler portions of the day, and also that it bears analogous relations to the seasons in that it is more frequent during the summer and fall than during the winter and spring. Hence, one would infer, as does Hann,[1] that the cirrus is most abundant in the Tropics and decreases toward the poles. This inference is accepted here as being correct, and is strongly supported by van Bemmelen's statement [2] that at Batavia there is almost always a cirrus veil at an elevation of about 11 kilometers. It is also supported by the monthly reports of cloud observations taken at various places in the Philippines,[1] and by observations in other parts of the Tropics. Clouds of this nature are always well above the effective radiating level of the atmosphere, and hence are in position to modify the temperature of the isothermal region, through the interception of outgoing radiation, while clouds below the effective level can have no such direct influence. The cirri are *outside* the earth as a radiator; the lower clouds *within* it.

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[1] Lehrbuch der Meteorologie, p. 214, 1906.

[2] Met. Zeit., 28, 213, 1911.

We do not know the exact extent and duration of these clouds at different parts of the earth nor their reflecting power for earth radiation, and hence only qualitative values are possible. We do know, however, that these and other clouds when at all dense reflect approximately 70 per cent of solar radiation, and that even thin cirrus transmits but little solar energy. Also,[2] that a layer of water, and presumably of ice, 0.1 millimeter thick, is almost wholly opaque to radiations whose wave lengths are greater than 2μ. Presumably, too, though the exact value is not known, the cirrus considerably reflects long wave-length earth radiation. That it reflects this radiation to some extent is, of course, quite certain.

Now, consider the effects of a perfect reflector at the level of the cirrus. With the outgoing radiation completely returned the temperature of everything below the reflector would rise finally to that of the effective radiating surface, assuming it to be constant, while everything above the reflector, assuming absence of insolation and no conduction through the reflector, would sink to the temperature of space. Hence, the cirrus, because it is a partial reflector of long wave lengths, and also because it lets solar radiation in better than it lets earth radiation out necessarily leads to an increase in the temperature of the atmosphere below it. Nor is this action confined to reflection and transmission alone, for absorption by the cirrus must also raise the temperature of the middle layers of the atmosphere, because in reradiating what it had absorbed one-half is returned and the rest only given off to space.

If the atmosphere of the equatorial regions were confined within cells with vertical walls, a state of equilibrium would be reached when each cell lost by radiation as much energy as it gained from without. But with the sides open, as they actually are, the increase of temperature below the cirrus can not be sufficient to establish radiation equilibrium, because it at the same time raises the general level of the lower atmosphere and thus increases its horizontal flow, a movement in which the air of the isothermal region presumably takes no prominent part. Hence, a portion of the heat of the tropics is prevented by the high cirrus shield from directly escaping as earth radiation, and thus is made to increase the planetary circulation by which it in turn is given opportunities to escape, as radiation to space, at higher latitudes where presumably the cirrus is less general. Indeed the mere existence of an equator to pole and return circulation shows that in equatorial regions the gain of sensible heat by insolation is greater than its loss by radiation, and that in high latitudes the reverse is the case, that here the gain of sensible heat by insolation is less than its loss by radiation.

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[1] Monthly Bulletin, Philippine Weather Bureau.

[2] Coblentz, Phys. Rev. 30, 322, 1910.

Taking the temperature of the isothermal region of middle latitudes to be −56° C. and that of this region over the equator to be −70° C., values closely in accord with observation, it follows, assuming the applicability of the Stefan equation, that the absolute temperatures of the corresponding effective radiating layers are 258° C. and 242° C., respectively, and that the intensities of the outgoing radiation are to each other as 22 to 17, in favor of the higher latitudes.

Now the average insolation at the equator is to that at latitude 40°, excluding the effects of clouds, roughly as 4 to 3. The effective ratio, however, must be less than this, assuming a greater amount of cirrus in equatorial regions, say 11 to 9. Similarly the cirrus partially arrests the outgoing radiation of the Tropics, and arrests this even more effectively than it does the incoming radiation. Let one fifth the equatorial earth radiation be arrested and sent to higher latitudes to escape. This will change the ratio from 11 to 9 into 8.9 to 11.1, or roughly 22 to 17 as above in favor of middle latitudes, assuming both of equal areas.

Confessedly these calculations are only approximations based on most imperfect data, but it is believed that they are qualitatively correct, and possibly even of the right order of magnitude.

This general effect of a cirrus shield is in accord with the fact that the lowest temperature of the isothermal region (see Table I) was found at Batavia during the most rainy season, and its highest temperature, for any place near the equator, in central Africa with serene skies.

Doubtless this is not the whole story, but the phenomena of the isothermal region certainly are phenomena essentially of radiation and absorption, and therefore a cirrus shield at the under surface of this region would distinctly influence both its height and its temperature.

CONCLUSION.

The assumption that the height and temperature of the isothermal region are determined essentially by outgoing earth radiation has but one serious objection. This is, the fact that near the equator, where the surface temperature is highest, the isothermal region is not correspondingly warmer than elsewhere, as one would expect, but on the contrary much colder.

It is suggested that a greater prevalence of cirrus clouds in the equatorial regions than elsewhere, and this seems to be the case, would largely account for the observed facts in regard to the temperature and height of the isothermal region. These clouds, if present, must act as a shield and partially protect the outer atmosphere from the radiation of lower levels, and thus allow it to grow cold through its own radiation to space. The somewhat entrapped heat below the cirrus would expand the atmosphere and thus increase its horizontal flow to higher latitudes where presumably there is less cirrus and freer direct radiation from the denser and lower atmosphere, and hence a warmer isothermal region.

Table I.—*Relations of isothermal region to latitude.*

	1	2	3	4	5
General condition of weather	Very rainy.	Rainy.	Serene.	Fair.	Fair.
Height of isothermal region ... km	17.5	16.3	15	14	12.8
Temperature of isothermal region	−80° C.	−73° C.	−67° C.	−65° C.	−59° C.
Surface temperature	24° C.	24° C.	24° C.	24° C.	27° C.
Temperature difference	104° C.	97° C.	91° C.	89° C.	86° C.
Number of observations	3	3	3	1	2
Latitude	6° S.	6° S.	1° S.	19° N.	26° N.

	6	7	8	9	10	11
General condition of weather	Fair.	Mixed.	Mixed.	Mixed.	Mixed.	(?)
Height of isothermal region ... km	12.6	12.5	12	10.6	9.6	9.5
Temperature of isothermal region	−57° C.	−57° C.	−56° C.	−56° C.	−55° C.	−60° C.
Surface temperature	24° C.	17° C.	19° C.	10° C.	5° C.	− 9° C.
Temperature difference	81° C.	74° C.	75° C.	66° C.	60° C.	51° C.
Number of observations	7	22	9	294	28	(?)
Latitude	34° N.	38° N.	40° N.	49° N.	60° N.	68° N

Table II.—*Source of data in Table I.*

	Where obtained.	By whom reported.
Columns 1 and 2	Batavia	W. van Bemmelen.[1]
Column 3	Schirati, Lake Victoria Nyanza	Arthur Berson.[2]
Columns 4, 5, and 6	Atlantic Ocean	L. Teisserenc de Bort and A. Lawrence Rotch.[3]
Column 7	St. Louis, Mo	A. Lawrence Rotch.[4]
Column 8	Indianapolis, Ind., and Omaha, Nebr.	W. R. Blair.[5]
Column 9	Europe	Arthur Wagner.[6]
Column 10	Pavlovsk	E. Gold and W. A. Harwood.[7]
Column 11	Kiruna, Sweden	L. Teisserenc de Bort.[8]

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[1] Met. Zeit. 28, 209, 1911.

[2] Bericht über die aerologische expedition des königlichen aeronautischen observatoriums nach Ost-Afrika im jahr 1908. Braunschweig, 1910.

[3] Etudes de l'atmosphère marine par sondages aériens. Paris, 1909.

[4] Annals Harvard College Observatory, 68, Pt. I.

[5] Bulletin of the Mount Weather Observatory, 3, 127, 1910.

[6] Beiträge zur physik der freien atmosphäre, 3, 57, 1909.

[7] Nature, 82, 49, 1909.

[8] C. R. 145, 1907.

(XIII) METEOROLOGICAL PHOTOGRAPHS.

C. FITZHUGH TALMAN, *Librarian.*

The United States Weather Bureau is forming in its library at Washington a collection of meteorological photographs and will welcome additions thereto from all parts of the world. The following classes of pictures are among those desired:

(1) Views of meteorological offices, observatories and stations.

(2) Pictures of meteorological apparatus.

(3) Portraits of meteorologists; views of their homes and birthplaces.

(4) Views showing the effects of storms, inundations, freezes, heavy snowfall, etc.

(5) Cloud photographs.

(6) Photographs of optical phenomena (rainbows, halos, Brocken specter, mirage, etc.).

(7) Photographs of lightning and its effects.

(8) Photographs of meteorologically interesting pictures in old books or of early prints and paintings. (E. g., contemporary pictures of the damage wrought by the great storm of 1703 in England.)

Persons who are willing to present such pictures to the Weather Bureau, or who will furnish them in exchange for Weather Bureau publications, are requested to address:

CHIEF U. S. WEATHER BUREAU,
WASHINGTON, D. C.
(Library.)

It will add much to the value of these pictures if the sender will kindly note on the back of each as much pertinent information as practicable. On pictures of classes 4–7, inclusive, should be stated at least the date, hour, and place at which each picture was taken and the direction toward which the camera was pointed.

(XIV) FREE AIR DATA AT MOUNT WEATHER FOR APRIL, MAY, AND JUNE, 1911.

By the Aerial Section—WILLIAM R. BLAIR in charge.

In the 91 days of this period, 94 free air observations were made; 65 with kites, 28 with captive balloons, and 1 with a pilot balloon. The mean of the highest points reached with the kites is 2,944 meters above sea level in April, 3,408 in May, 3,489 in June, and 3,257 in the period. Similar means for the balloons are 2,192 in April, 2,057 in May, 2,008 in June, and 2,072 in the period. The pilot balloon disappeared at an altitude of 2,626 meters above sea level. The highest kite flight of the period, 5,676 meters above sea level, was made on April 24; the highest balloon ascension, 3,254 meters above sea level, on May 6.

This period completes the fourth year of daily free air observations by means of kites and balloons. In the year, 368 observations were made; 299 kite flights and 69 captive balloon ascensions. The average altitude reached with the kite is 2,929 meters above sea level, with the balloons, 2,150. Sixty-seven flights were over 4,000 meters above sea level; of these 13 were over 5,000, one of the 13 being over 6,000. The summary of the data for the four years will appear in a later number of this Bulletin.

The prevailing wind direction was northwest in April and west in May and June. The mean wind velocity was 7.5 meters per second in April, 5.4 in May, and 5.7 in June. The April wind velocity is about the average for this month in the last four years, that of May is low and that of June high. The number and altitude of the kite flights made in June are exceptionally high for the month; those made in May are above the average.

A comparison of the free air isotherms of this period, Charts VII to XII, with those of January, February, and March, Charts I to VI, while it shows fewer inversions of temperature in the summer than in the winter months, shows 13 inversions of temperature above the 3,000 meter level in the later period and 4 in the earlier. These inversions owe their existence to the condensation or to the evaporation of the moisture in the air. (See p. 40, Vol. III of this bulletin.)

Their presence at greater altitudes in the summer months points to the fact that the lower or moist stratum of the atmosphere is deeper in summer than in winter and that condensation takes place at higher levels. (P. 73, Vol. II of this bulletin.)

The mean hourly temperatures at the mountain and valley stations for the three months are shown in figures 4, 5, and 6. The mean daily range of temperature at Trapp and Mount Weather differs but little in the months of April and June. The Trapp range is only 1.5 greater in May, although that month was exceptionally dry and clear. The mean daily range of temperature at Audley was greater than that at Mount Weather by 2.4° in April, 4.8° in May, and 3.8° in June. The May ranges are unusually large; 13.7° at Audley. These facts are well in accord with the following table of cloudiness for the period, and support the conclusion stated on page 305, Volume III, of this bulletin, i. e., that the drainage of colder air from the mountain top largely controls the temperature at Trapp, while direct insolation and radiation play the more important part at Audley.

Month.	Number of days.			Mean cloudiness, in tenths.
	Cloudy.	Partly cloudy.	Clear.	
April	14	9	7	6.5
May	2	10	19	3.3
June	8	13	9	5.5

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 1:	mm.	° C.	%		m. p. s.	m.	mm.	° C.	%		m. p. s.
8.07 a. m.	713.6	−0.5	65	wnw.	7.2	526	713.6	− 0.5	65	wnw.	7.2
8.14 a. m.	713.6	0.0	65	nw.	7.2	841	685.9	− 4.3	......	nw.	....
9.12 a. m.	713.5	0.2	63	wnw.	6.3	1,327	644.4	− 9.3	......	wnw.	....
9.42 a. m.	713.4	1.1	53	wnw.	8.0	2,191	575.6	−14.6	......	wnw.	....
10.15 a. m.	713.2	1.6	51	nw.	12.5	3,649	473.5	−22.8	......	w.	....
10.46 a. m.	713.1	1.7	57	wnw.	14.3	2,559	548.3	−17.0	......	wnw.	....
10.57 a. m.	713.1	1.8	55	wnw.	9.8	2,075	584.7	−13.6	......	wnw.	....
11.08 a. m.	713.1	2.1	40	wnw.	11.6	1,439	635.1	− 9.1	......	wnw.	....
11.24 a. m.	713.0	2.0	40	wnw.	13.4	878	682.3	− 3.7	......	wnw.	....
11.29 a. m.	713.0	2.2	39	wnw.	10.7	526	713.0	2.2	39	wnw.	10.7

April 1.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m., at maximum altitude.

There were a few to 4/10 St.-Cu. from the west-northwest at an altitude of 1,300 m. Pressure was low over the Gulf of St. Lawrence and high over Minnesota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 2:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.35 a. m....	719.6	−4.6	67	w.	7.6	526	719.6	− 4.6	67	w.	7.6
8.48 a. m....	719.6	−4.2	59	wnw.	11.6	1,040	673.8	− 8.9	......	wnw.	....
8.51 a. m....	719.6	−4.2	59	wnw.	11.6	1,124	666.5	− 8.3	......	wnw.	....
9.16 a. m....	719.6	−3.8	55	wnw.	10.3	1,964	597.7	−11.9	......	nw.	....
9.27 a. m....	719.6	−3.4	52	wnw.	9.4	2,109	586.7	−10.4	......	wnw.	....
9.46 a. m....	719.6	−2.6	53	wnw.	11.2	2,352	568.5	−10.9	......	wnw.	....
10.03 a. m....	719.6	−1.8	49	wnw.	8.9	2,928	527.4	−13.5	......	wnw.	....
10.31 a. m....	719.6	−1.4	48	nw.	10.3	2,207	579.5	−11.3	......	nw.	....
11.07 a. m....	719.6	−1.0	48	nw.	11.2	1,914	602.0	−12.3	......	wnw.	....
11.19 a. m....	719.6	−0.6	41	wnw.	12.5	1,617	626.0	−10.7	......	wnw.	....
11.32 a. m....	719.6	−0.4	42	wnw.	9.4	964	680.9	− 5.7	......	wnw.	....
11.40 a. m....	719.6	−0.3	40	wnw.	11.6	526	719.6	− 0.3	40	wnw.	11.6
Apr. 3:											
9.49 a. m....	721.7	− 3.0	100	e.	8.0	526	721.7	− 3.0	100	e.	8.0
10.18 a. m....	721.6	− 3.1	100	e.	8.0	938	684.9	− 5.6	......	e.	....
10.33 a. m....	721.7	− 3.2	100	e.	6.7	957	683.2	− 5.7	......	e.	....
11.05 a. m....	721.7	− 3.1	100	e.	8.0	1,063	674.2	− 3.5	......	ese.	....
11.17 a. m....	721.7	− 3.0	100	e.	7.4	719	704.3	− 5.2	......	ese.	....
11.24 a. m....	721.7	− 3.0	100	e.	7.4	526	721.7	− 3.0	100	e.	7.4
Apr. 4:											
4.53 p. m....	718.5	− 0.1	100	se.	5.8	526	718.5	− 0.1	100	se.	5.8
5.02 p. m....	718.5	0.0	100	ese.	8.5	982	679.1	4.5	......	s.	....
5.10 p. m....	718.5	0.0	100	ese.	8.9	770	697.1	1.1	......	s.	....
5.25 p. m....	718.5	0.0	100	ese.	8.9	526	718.5	0.0	100	ese.	8.9
Apr. 5:											
10.18 a. m....	709.4	12.5	100	s.	8.5	526	709.4	12.5	100	s.	8.5
10.26 a. m....	709.3	12.5	100	s.	8.5	963	673.5	15.9	......	sw.	....
10.32 a. m....	709.3	12.6	100	s.	8.5	1,148	659.1	14.4	......	sw.	....
10.35 a. m....	709.3	12.6	100	s.	8.9	1,385	641.0	15.0	......	wsw.	....
10.47 a. m....	709.1	12.7	100	s.	9.8	1,838	607.2	11.9	......	wsw.	....
11.03 a. m....	709.0	12.8	99	s.	10.3	2,278	575.7	8.3	......	wsw.	....
11.40 a. m....	708.9	13.4	98	s.	10.7	1,828	607.2	10.2	......	wsw.	....
11.50 a. m....	708.9	13.5	97	s.	10.7	1,377	641.0	11.5	......	wsw.	....
12.04 p. m....	708.9	13.6	96	s.	9.8	959	673.5	14.4	......	sw.	....
12.09 p. m....	708.9	13.5	97	s.	8.9	526	708.9	13.5	97	s.	8.9

April 2.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,500 m.

There were a few St.-Cu. from the west-northwest. From 2/10 to a few Ci. from the west-northwest were visible after 11.05 a. m.

Pressure was high over Ohio and low over Newfoundland.

April 3.—Four kites were used; lifting surface, 23.4 sq. m. Wire out, 3,000 m.; at maximum altitude, 1,700 m.

Light snow was falling and dense fog prevailed.

An extensive high-pressure area was central over Ontario. There were marked centers of low pressure over Utah and New Mexico.

April 4.—One kite was used; lifting surface, 6.3 sq. m. Wire out, 1,000 m.; at maximum altitude, 600 m.

There was dense fog and light rain.

Pressure was high over Maine and low over Arkansas.

April 5.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 4,500 m., at maximum altitude.

The sky was overcast with A.-St. from the west-southwest; there were also 3/10 to 8/10 St. from the south at an altitude of 700 m.

An active low, accompanied by general precipitation, was central over the upper lakes. Pressure was high over the Gulf of St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind. Direction.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind. Direction.	Wind. Velocity.
1911.											
Apr. 6:											
First flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7.58 a. m....	712.7	13.2	59	wsw.	9.8	526	712.7	13.2	59	wsw.	9.8
8.07 a. m....	712.7	13.4	59	wsw.	6.7	947	678.0	12.4	......	wsw.	....
8.29 a. m....	712.8	13.4	61	wsw.	6.7	1,060	669.0	14.5	......	wsw.	....
9.00 a. m....	712.9	14.1	66	wsw.	3.6	1,515	634.2	11.8	......	wsw.	....
9.14 a. m....	712.9	13.9	68	wsw.	2.7	1,085	667.2	13.7	......	wsw.	....
9.24 a. m....	712.9	13.7	69	se.	3.1	840	686.8	12.7	......	wsw.	....
9.30 a. m....	712.9	13.7	69	se.	3.1	526	712.9	13.7	69	se.	3.1
Second flight—											
10.49 a. m....	712.6	16.4	68	sse.	8.0	526	712.6	16.4	68	sse.	8.0
10.53 a. m....	712.6	16.3	63	sse.	8.0	679	699.9	13.8	......	s.	....
11.02 a. m....	712.6	16.7	59	sse.	9.8	1,098	666.2	14.9	......	s.	....
11.18 a. m....	712.4	17.9	57	se.	9.4	2,029	596.2	8.5	......	ssw.	....
11.29 a. m....	712.3	17.7	53	se.	8.0	2,141	588.2	8.9	......	ssw.	....
12.03 p. m....	712.0	18.5	48	se.	9.8	3,372	505.9	0.9	......	sw.	....
12.21 p. m....	711.9	19.0	44	sse.	7.2	3,607	491.2	− 1.1	......	wsw.	....
12.45 p. m....	711.8	20.1	43	sse.	8.0	4,018	466.5	− 3.8	......	wsw.	....
1.18 p. m....	711.4	19.9	39	se.	8.9	3,577	493.0	− 1.0	......	wsw.	....
1.40 p. m....	711.1	20.5	41	s.	9.8	3,366	505.9	1.0	......	wsw.	....
2.22 p. m....	710.4	20.8	43	sse.	8.9	2,624	553.7	5.4	......	wsw.	....
2.46 p. m....	710.2	21.9	38	s.	10.7	2,387	570.0	8.0	......	wsw.	....
3.16 p. m....	709.8	21.8	45	ssw.	10.7	1,932	601.6	11.5	......	sw.	....
3.42 p. m....	709.6	22.0	45	s.	10.7	887	680.5	16.4	......	ssw.	....
3.51 p. m....	709.5	21.4	44	s.	10.7	526	709.5	21.4	44	s.	10.7
Apr. 7:											
8.04 a. m....	712.5	10.4	77	nw.	14.8	526	712.5	10.4	77	nw.	14.8
8.09 a. m....	712.6	10.1	77	nw.	14.3	831	686.9	7.4	......	nw.	....
8.19 a. m....	712.7	10.0	78	nw.	12.5	1,071	667.3	9.6	......	wnw.	....
8.24 a. m....	712.8	10.0	79	nw.	12.1	1,446	637.9	7.6	......	w.	....
8.34 a. m....	712.9	9.9	77	nw.	12.1	1,564	629.0	9.5	......	w.	....
8.54 a. m....	713.1	8.3	80	nw.	10.7	2,491	562.0	5.4	......	w.	....
9.16 a. m....	713.4	7.1	78	nw.	11.2	3,473	497.8	− 2.0	......	w.	....
11.03 a. m....	714.4	6.4	76	nw.	11.6	2,185	583.9	6.7	......	w.	....
11.29 a. m....	714.6	6.6	76	nw.	11.6	1,529	632.5	7.5	......	w.	....
11.47 a. m....	714.7	7.2	72	nw.	11.6	981	676.1	7.5	......	wnw.	....
12.00 m......	714.8	7.4	69	nw.	8.5	876	685.1	4.5	......	nw.	....
12.04 p. m...	714.8	7.4	69	nw.	8.5	526	714.8	7.4	69	nw.	8.5

April 6.—First flight: Three kites were used; lifting surface, 19.4 sq. m. Wire out, 1,600 m.; at maximum altitude.

From 7/10 to 8/10 A.-St. were observed before 9 a. m. and 3/10 A.-St. and 4/10 A.-Cu. thereafter, all from the west-southwest.

Second flight.—Five kites were used; lifting surface, 32.5 sq. m. Wire out, 8,000 m.; at maximum altitude.

Ci. and Ci. St. to the amount of 5/10 from the west-northwest, with 1/10 A.-Cu., from the west-southwest and a few A.-St. of indeterminate direction were observed before 12 m., after which from 8/10 to 1/10 A.-St. from the west-northwest and 1/10 to 3/10 A.-Cu. from the west prevailed.

At 8 a. m. there was an active low central over Illinois. A second low was over the lower St. Lawrence Valley and pressure was moderately high off the south Atlantic coast.

April 7.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 6,000 m., at maximum altitude.

There were from 6/10 to 10/10 St.-Cu. from the west. These gradually changed to A.-Cu. There were a few Ci-St. from the west from 8.41 to 9.16 a. m. Light rain fell from 9.16 to 10.59 a. m.

Pressure was low over Quebec and high over Illinois.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
				Wind.						Wind.	
	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.
1911.											
Apr. 8:	*mm.*	°*C.*	%		*m. p. s.*	*m.*	*mm.*	°*C.*	%		*m. p. s.*
9.50 a. m....	719.8	0.7	100	ese.	6.7	526	719.8	0.7	100	ese.	6.7
10.02 a. m....	719.7	0.8	100	ese.	6.7	782	697.1	—1.7	......	ese.	....
10.21 a. m....	719.6	0.7	100	ese.	7.2	903	686.5	0.2	......	se.	....
10.42 a. m....	719.5	0.8	100	ese.	5.4	966	681.0	—1.1	......	se.	....
10.50 a. m....	719.4	0.8	100	ese.	4.5	1,220	659.6	—1.5	......	se.	....
10.59 a. m....	719.4	0.8	100	ese.	4.0	526	719.4	0.8	100	ese.	4.0
Apr. 9:											
First flight—											
8.33 a. m....	718.8	—0.6	100	nw.	10.7	526	718.8	— 0.6	100	nw.	10.7
8.44 a. m....	719.1	—0.5	100	nw.	8.9	891	686.9	— 1.6	......	nnw.	....
9.09 a. m....	719.6	—0.2	100	nw.	....	1,652	624.9	— 1.9	......	n.	....
9.13 a. m....	719.6	—0.2	100	nw.	10.7	526	719.6	— 0.2	100	nw.	10.7
Second flight—											
11.52 a. m....	721.0	1.8	74	nw.	11.6	526	721.0	1.8	74	nw.	11.6
11.59 a. m....	721.0	1.6	77	nw.	12.1	951	683.7	— 2.6	......	nw.	....
12.10 p. m....	721.0	1.8	75	nw.	11.6	1,516	636.4	— 5.7	......	nw.	....
12.22 p. m...	721.1	1.9	76	nw.	11.6	1,726	619.8	— 5.2	......	nnw.	....
12.35 p. m...	721.1	2.6	72	nw.	12.5	2,438	566.0	— 7.3	......	nnw.	....
12.58 p. m...	721.2	3.0	75	nw.	10.7	2,972	528.5	—10.4	......	n.	....
1.02 p. m...	721.2	3.2	75	nw.	9.8	3,135	517.6	— 9.7	......	n.	....
1.19 p. m...	721.3	2.9	75	nnw.	10.7	3,792	475.3	—10.6	......	n.	....
1.36 p. m...	721.3	3.4	75	nnw.	10.7	3,571	489.5	— 9.1	......	n.	....
1.42 p. m...	721.3	3.4	75	nnw.	8.0	3,268	509.1	— 8.7	......	n.	....
1.59 p. m...	721.4	3.7	67	nw.	9.8	2,952	530.4	— 6.4	......	n.	....
2.08 p. m...	721.4	4.0	68	nw.	10.7	2,792	541.4	— 8.1	......	n.	....
2.27 p. m...	721.5	4.0	68	nw.	11.6	2,225	582.3	— 4.1	......	n.	....
2.32 p. m...	721.5	4.0	68	nnw.	11.6	1,734	619.8	— 6.3	......	nnw.	....
2.41 p. m...	721.5	4.9	68	nw.	8.9	1,434	644.0	— 5.1	......	nw.	....
2.55 p. m...	721.6	4.4	71	nnw.	9.8	858	692.6	— 0.1	......	nnw.	....
3.00 p. m...	721.6	4.9	63	nnw.	9.8	526	721.6	4.9	63	nnw.	9.8

April 8.—Three kites were used; lifting service, 18.9 sq. m. Wire out, 2,000 m., at maximum altitude, 1,100 m.

Dense fog and light rain prevailed throughout the flight.

Pressure was high over the lake region and relatively low over western North Carolina.

April 9.—*First flight.* Three kites were used; lifting surface, 16.2 sq. m. Wire out, 3,000 m., at maximum altitude.

St.-Cu. from the north decreased from 10/10 at the beginning to 9/10 at 9.13 a. m., when a few A.-St. of indeterminable direction appeared.

Second flight. Five kites were used; lifting surface, 31.5 sq. m. Wire out 6,500 m., at maximum altitude, 6,200 m.

St.-Cu. from the north, shifting to the north-northwest, decreased from 9/10 to 5/10; altitude about 1,400 m.

A trough of moderately low pressure extended along the Atlantic coast from New England to Florida. A high of considerable strength was central over northern Illinois.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 10:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
4.38 p. m.	725.8	11.0	38	e.	3.6	526	725.8	11.0	38	e.	3.6
5.03 p. m.	725.6	10.3	36	ene.	3.1	1,830	618.0	− 1.1	......	nnw.	....
5.12 p. m.	725.6	10.0	42	ne.	3.6	1,570	638.4	1.0	......	nw.	....
5.22 p. m.	725.7	9.7	39	ne.	3.6	1,033	682.4	4.4	......	nne.	....
5.30 p. m.	725.8	9.8	42	ene.	2.7	654	714.6	7.1	......	nne.	....
5.35 p. m.	725.8	9.8	42	ene.	2.7	526	725.8	9.8	42	ene.	2.7
Apr. 11:											
10.29 a. m.	726.8	7.1	59	ese.	7.6	526	726.8	7.1	59	ese.	7.6
12.55 p. m.	726.6	10.4	42	ese.	9.4	1,145	673.9	2.5	......	se.	....
1.38 p. m.	726.3	10.6	40	ese.	13.0	1,853	616.5	− 4.1	......	sse.	....
2.09 p. m.	726.0	10.4	36	ese.	13.0	2,071	599.5	− 2.1	......	se.	....
2.14 p. m.	726.0	10.5	36	ese.	11.2	2,269	584.9	− 1.6	......	se.	....
2.22 p. m.	726.0	10.5	39	ese.	12.1	2,198	590.4	− 1.5	......	sse.	....
2.36 p. m.	725.9	10.5	38	ese.	12.5	2,026	603.1	− 3.6	......	se.	....
2.52 p. m.	725.8	10.7	40	ese.	10.3	1,525	642.3	− 0.1	......	se.	....
3.02 p. m.	725.7	10.8	40	se.	8.9	1,094	677.4	3.9	......	se.	....
3.13 p. m.	725.5	11.0	38	se.	10.7	526	725.5	11.0	38	se.	10.7
Apr. 12:											
10.09 a. m.	726.4	3.0	92	ese.	11.6	526	726.4	3.0	92	ese.	11.6
10.18 a. m.	726.4	3.7	91	ese.	10.7	884	694.8	− 0.1	......	se.	....
10.27 a. m.	726.4	4.2	89	ese.	10.7	1,137	673.4	2.8	......	se.	....
10.40 a. m.	726.4	4.2	85	ese.	10.3	1,498	644.0	1.6	......	sse.	....
11.01 a. m.	726.4	4.7	81	ese.	12.5	2,226	588.2	− 1.5	......	sse.	....
11.23 a. m.	726.4	5.2	76	ese.	12.5	2,657	557.2	− 3.8	......	s.	....
11.37 a. m.	726.4	5.7	76	se.	12.5	3,066	528.9	− 5.7	......	s.	....
11.41 a. m.	726.4	5.8	76	se.	10.7	3,232	517.9	− 5.1	......	s.	....
1.24 p. m.	726.0	7.5	68	se.	11.6	3,890	475.6	−10.6	......	s.	....
1.29 p. m.	726.0	8.0	68	se.	12.5	4,005	468.7	− 9.7	......	s.	....
1.44 p. m.	725.9	7.7	71	se.	10.7	4,541	437.3	−11.2	......	s.	....
2.22 p. m.	725.8	8.0	69	se.	10.7	3,902	473.7	− 8.5	......	s.	....
2.29 p. m.	725.8	8.1	68	ese.	13.0	3,828	479.3	−10.5	......	s.	....
2.58 p. m.	725.7	8.6	68	se.	11.2	2,899	539.9	− 4.2	......	s.	....
3.15 p. m.	725.7	9.0	67	se.	10.7	2,318	580.9	− 0.9	......	s.	....
3.35 p. m.	725.7	8.7	68	ese.	11.6	1,408	646.2	− 1.1	......	sse.	....
3.48 p. m.	725.7	8.7	68	ese.	12.1	905	693.0	3.3	......	se.	....
3.55 p. m.	725.7	8.9	70	ese.	11.6	526	725.7	8.9	70	ese.	11.6

April 10.—One balloon was used; capacity, 22.4 cu. m. Wire out, 2,600 m.

There were 4/10 Ci. from the west throughout the flight.

A high central over Lake Erie covered the country east of the Mississippi.

April 11.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 3,700 m.; at maximum altitude 3,100 m.

There were 7/10 to a few Ci.-Cu. from the west. A few St.-Cu. from the southeast were visible after 11.12 a. m.

Pressure was high over Quebec and low over Alberta.

April 12.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 10,500 m.; at maximum altitude, 9,500 m.

At the beginning of the flight there were 10/10 St. from the southeast; altitude, 800 m. These had dissipated by 11 a. m., and thereafter the sky was overcast with St.-Cu. from the south-southeast; altitude, 1,400 m. At intervals there were visible through openings in the St.-Cu. 1/10 to 2/10 high A.-St. from the south.

A large high was central over New England and a well-developed low over Colorado and Kansas.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 13:	*mm.*	° *C.*	%		*m.p.s.*	*m.*	*mm.*	° *C.*	%		*m.p.s.*
12.47 p.m....	725.7	13.0	70	sse.	9.8	526	725.7	13.0	70	sse.	9.8
12.57 p.m....	725.6	13.2	68	sse.	10.3	881	695.5	8.6	......	sse.	....
1.10 p.m....	725.6	13.4	71	sse.	10.7	1,527	642.9	3.7	......	sse.	....
1.23 p.m....	725.5	13.3	73	sse.	10.7	1,936	611.3	2.7	......	s.	....
1.28 p.m....	725.5	13.4	72	sse.	11.2	2,363	579.8	0.5	......	s.	....
1.38 p.m....	725.5	13.0	73	sse.	11.2	2,464	572.5	1.3	......	s.	....
1.49 p.m....	725.4	13.2	72	sse.	10.3	2,978	536.9	− 1.6	......	ssw.	....
2.06 p.m....	725.4	13.1	71	sse.	10.3	3,381	510.1	− 3.8	......	ssw.	....
2.38 p.m....	725.3	13.3	71	sse.	8.0	3,834	481.8	− 2.0	......	sw.	....
2.44 p.m....	725.3	13.4	71	sse.	8.9	3,892	478.1	− 2.6	......	sw.	....
2.50 p.m....	725.2	13.5	68	sse.	8.5	3,830	481.8	− 2.3	......	sw.	....
3.01 p.m....	725.2	13.5	68	sse.	8.9	3,347	512.0	− 4.4	......	ssw.	....
3.09 p.m....	725.2	13.6	66	sse.	10.3	2,973	536.9	− 2.6	......	ssw.	....
3.20 p.m....	725.0	13.6	67	sse.	9.8	2,433	574.3	1.4	......	ssw.	....
3.23 p.m....	724.9	13.6	67	sse.	10.3	2,023	604.1	1.4	......	s.	....
3.30 p.m....	724.8	13.7	65	sse.	9.4	1,495	644.7	3.6	......	s.	....
3.42 p.m....	724.7	13.9	67	sse.	9.8	935	690.1	8.5	......	sse.	....
3.49 p.m....	724.6	13.8	67	sse.	11.6	526	724.6	13.8	67	sse.	11.6
Apr. 14:											
8.33 a. m.....	720.6	11.6	96	ssw.	9.8	526	720.6	11.6	96	ssw.	9.8
8.38 a. m....	720.6	11.6	97	ssw.	8.9	1,051	676.7	9.7	......	ssw.	....
8.49 a. m....	720.6	11.7	96	ssw.	6.3	1,367	651.3	6.7	......	ssw.	....
8.55 a. m....	720.5	11.7	96	ssw.	6.7	1,656	629.0	8.4	......	sw.	....
9.02 a. m....	720.5	11.7	96	s.	6.7	1,975	605.0	6.8	......	sw.	....
9.15 a. m....	720.6	11.7	96	s.	8.0	2,185	589.8	5.8	......	wsw.	....
9.30 a. m....	720.4	11.7	96	s.	8.0	526	720.4	11.7	96	s.	8.0
Apr. 15:											
1.04 p. m...	715.7	9.4	42	wnw.	8.5	526	715.7	9.4	42	wnw.	8.5
1.22 p. m...	715.5	9.5	41	wnw.	8.0	897	684.1	4.5	......	wnw.	....
1.37 p. m...	715.2	10.2	38	wnw.	9.4	1,590	627.5	−1.9	......	wnw.	....
1.59 p. m...	715.0	11.0	36	wnw.	7.2	2,318	572.1	−8.1	......	wnw.	....
2.16 p. m...	714.8	10.9	35	wnw.	7.2	2,790	537.7	−11.9	......	wnw.	....
2.30 p. m...	714.6	11.8	36	wnw.	8.9	2,393	566.0	−10.0	......	wnw.	....
2.41 p. m...	714.4	12.0	35	wnw.	10.7	1,583	627.5	− 2.7	......	wnw.	....
2.57 p. m...	714.1	12.4	29	wnw.	12.1	956	678.1	5.5	......	w.	....
3.09 p. m...	713.9	12.6	25	wnw.	11.2	526	713.9	12.6	25	wnw.	11.2

April 13.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 7,000 m.; at maximum altitude, 5,300 m.

St.-Cu. from the south-southeast, altitude about 1,400 m., diminished from 10/10 to 5/10. Above them the sky was covered with A.-St. from the southwest.

Pressure was high over New England and low over Manitoba and Arkansas.

April 14.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4,500 m.; at maximum altitude, 4,300 m.

There were 3/10 St.-Cu. from the southwest and 7/10 low St. from the south. Rain began at 8.58 a. m.

Pressure was low north of Lake Superior and high off the Atlantic coast.

April 15.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4,000 m.; at maximum altitude, 3,800 m.

There were 5/10 to 6/10 Ci. and Ci.-Cu. from the west and 2/10 to a few St.-Cu. from the west-northwest. A solar halo was observed.

Pressure was high over Wyoming and low over Maine, with a secondary depression on the Carolina coast.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 16:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.55 a. m....	714.5	3.0	37	nw.	13.4	526	714.5	3.0	37	nw.	13.4
9.01 a. m....	714.5	3.0	37	nw.	13.4	902	681.9	− 0.9	......	nw.	....
9.41 a. m....	714.4	3.6	33	wnw.	14.3	1,384	641.7	− 4.8	......	wnw.	....
10.30 a. m....	714.2	4.8	32	wnw.	18.8	1,997	593.1	− 9.9	......	wnw.	....
10.51 a. m....	714.1	4.3	27	wnw.	19.7	2,429	560.4	−13.6	......	wnw.	....
11.05 a. m....	714.1	4.8	29	wnw.	17.9	2,116	584.0	−11.4	......	wnw.	....
11.30 a. m....	714.0	4.8	30	wnw.	17.9	1,424	638.1	− 4.8	......	wnw.	....
11.40 a. m....	714.0	4.2	35	nw.	17.9	898	681.9	− 0.4	......	nw.	....
11.48 a. m....	714.0	4.8	32	nw.	14.3	526	714.0	4.8	32	nw.	14.3
Apr. 17:											
2.00 p. m...	713.4	8.6	64	nw.	7.2	526	713.4	8.6	64	nw.	7.2
2.10 p. m...	713.4	9.6	59	nw.	7.2	834	687.2	4.9	......	nw.	....
2.22 p. m...	713.4	8.9	60	nw.	7.2	1,337	645.8	0.4	......	nw.	....
2.37 p. m...	713.4	9.8	48	nw.	9.8	1,881	603.0	− 3.8	......	nw.	....
2.47 p. m...	713.4	10.2	38	nw.	10.3	2,134	584.2	− 6.2	......	nw.	....
2.58 p. m...	713.4	10.1	38	nw.	14.8	2,861	532.2	− 9.1	......	wnw.	....
3.13 p. m...	713.4	9.6	33	nw.	15.6	3,759	473.5	−13.1	......	wnw.	....
3.45 p. m...	713.4	9.8	39	nw.	13.4	2,968	524.9	− 9.5	......	wnw.	....
4.05 p. m...	713.4	9.8	33	nw.	15.2	2,282	573.3	− 5.7	......	wnw.	....
4.18 p. m...	713.4	9.9	33	nw.	13.4	1,711	616.2	− 2.7	......	wnw.	....
4.33 p. m...	713.4	9.8	31	nw.	17.0	1,383	642.2	0.3	......	nw.	....
4.43 p. m...	713.4	9.8	32	nw.	16.1	877	683.6	4.8	......	nw.	....
4.50 p. m...	713.4	9.8	32	nw.	16.1	526	713.4	9.8	32	nw.	16.1
Apr. 18:											
7.57 a. m....	719.5	2.8	51	nw.	7.2	526	719.5	2.8	51	nw.	7.2
8.06 a. m....	719.5	3.2	51	nw.	7.6	857	690.6	− 0.5	......	nnw.	....
8.23 a. m....	719.5	3.4	51	nw.	8.0	1,240	658.4	0.8	......	nnw.	....
8.37 a. m....	719.6	3.8	51	nw.	7.6	1,925	604.6	− 0.1	......	nnw.	....
8.57 a. m....	719.6	4.0	51	nw.	7.6	2,945	532.0	− 4.0	......	nnw.	....
9.18 a. m....	719.6	4.4	48	nw.	7.6	3,726	481.8	− 5.2	......	nw.	....
9.55 a. m....	719.7	5.7	47	nw.	6.7	4,565	432.9	−10.5	......	nw.	....
10.51 a. m....	719.2	7.3	47	wnw.	5.4	3,668	485.6	− 5.7	......	nw.	....
11.18 a. m....	719.1	7.6	43	nnw.	3.6	2,924	533.8	− 4.2	......	nnw.	....
11.34 a. m....	718.9	8.6	41	nw.	4.0	1,931	604.6	0.3	......	nnw.	....
11.45 a. m....	718.8	8.5	41	wnw.	3.1	1,090	671.0	2.9	......	wnw.	....
11.51 a. m....	718.8	9.0	42	wnw.	2.7	526	718.8	9.0	42	wnw.	2.7

April 16.—Three kites were used; lifting surface, 16.2 sq. m. Wire out, 4,000 m., at maximum altitude.

Cu. from the west-northwest increased from few to 6/10.

Low pressure was central off the coast of Nova Scotia. High pressure was central over Louisiana.

April 17.—Three kites were used; lifting surface, 20.9 sq. m. Wire out, 5,000 m., at maximum altitude.

There were 3/10 to a few St.-Cu. from the west-northwest at an altitude of about 1,500 m.

Pressure was high over the Mississippi Valley and low over Nova Scotia. A secondary low was central over northern Virginia.

April 18.—Five kites were used; lifting surface, 33.5 sq. m. Wire out, 9,000 m., at maximum altitude.

Ci.-St., from the west-northwest, increased from few to 4/10.

Pressure was high over Virginia and low over Iowa.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 19:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.01 a. m....	714.2	9.4	62	sse.	7.2	526	714.2	9.4	63	sse.	7.2
8.05 a. m....	714.1	9.4	63	se.	7.2	829	688.7	13.5	......	ssw.	....
8.25 a. m....	713.8	9.2	65	se.	8.0	1,613	626.7	7.0	......	sw.	....
8.45 a. m....	713.5	9.3	76	sse.	7.2	2,291	576.6	2.0	......	ssw.	....
9.02 a. m....	713.3	9.2	63	se.	7.0	2,544	558.4	− 0.7	......	ssw.	....
9.40 a. m....	713.0	9.9	71	se.	8.0	2,697	547.5	− 2.7	......	ssw.	....
10.03 a. m....	712.9	10.2	70	sse.	8.0	3,038	524.6	− 1.7	......	ssw.	....
10.14 a. m....	712.8	10.4	75	sse.	8.9	3.502	494.1	− 4.9	......	ssw.	....
10.31 a. m....	712.7	10.8	67	sse.	7.2	2,850	535.6	− 1.6	......	ssw.	....
10.48 a. m....	712.7	10.9	67	sse.	5.4	2,596	552.9	− 1.7	......	ssw.	....
11.10 a. m....	712.5	10.7	77	s.	5.4	2,024	593.6	2.6	......	ssw.	....
11.23 a. m....	712.4	10.9	72	sse.	7.2	1.482	634.3	5.0	......	ssw.	....
11.32 a. m....	712.3	10.5	80	sse.	7.6	929	678.1	7.6	......	ssw.	....
11.38 a. m....	712.2	10.4	81	sse.	7.6	762	692.2	6.0	......	ssw.	....
11.41 a. m....	712.2	10.2	81	sse.	7.6	526	712.2	10.2	81	sse.	7.6
Apr. 20:											
11.12 a. m....	708.7	7.0	94	nnw.	8.0	526	708.7	7.0	94	nnw.	8.0
11.22 a. m....	708.8	7.4	91	nnw.	8.0	915	675.9	3.6	......	n.	....
11.46 a. m....	709.0	7.7	90	nnw.	8.0	1,480	630.6	1.8	......	n.	....
12.03 p. m...	709.1	7.2	90	nnw.	7.6	1,919	597.1	0.0	......	n.	....
12.29 p. m...	709.3	7.1	87	nnw.	8.9	2,589	549.1	− 3.0	......	n.	....
1.20 p. m...	709.8	7.2	85	n.	7.2	3,798	471.1	− 7.6	......	nnw.	....
2.17 p. m...	710.3	7.4	88	nnw.	5.8	4,356	438.4	−10.5	......	nnw.	....
3.15 p. m...	710.7	8.2	85	nnw.	4.0	3,456	492.1	− 6.8	......	nnw.	....
3.42 p. m...	710.9	8.8	81	nnw.	4.9	3.045	518.9	− 4.9	......	nnw.	....
3.53 p. m...	711.0	9.1	81	nnw.	5.4	2,855	531.7	− 5.9	......	nnw.	....
4.03 p. m...	711.0	9.0	76	nnw.	4.5	2,370	565.5	− 4.3	......	nnw.	....
4.15 p. m...	711.1	9.0	78	nw.	3.6	1,695	615.7	− 0.9	......	nnw.	....
4.27 p. m...	711.2	8.7	79	nnw.	3.1	898	679.7	4.0	......	n.	....
4.30 p. m...	711.2	8.5	79	nnw.	2.7	526	711.2	8.5	79	nnw.	2.7
Apr. 21:											
10.05 a. m....	713.5	8.6	44	ese.	1.8	526	713.5	8.6	44	ese.	1.8
10.22 a. m....	713.3	9.5	50	ese.	4.0	2,098	587.5	− 1.9	......	nw.	....
10.36 a. m....	713.1	9.6	50	ese.	4.0	1,649	621.3	− 0.7	......	wnw.	....
10.44 a. m....	713.0	9.6	50	calm.	0.0	1,364	643.7	2.1	......	wsw.	....
10.55 a. m....	712.8	9.6	48	ese.	5.4	855	685.1	6.2	......	calm.	....
11.04 a. m....	712.8	9.8	46	ese.	4.5	526	712.8	9.8	46	ese.	4.5

April 19.—Six kites were used; lifting surface, 38.3 sq. m. Wire out, 7,950 m.; at maximum altitude, 6,600 m.

There were 10/10 to 3/10 A.-Cu. from the south-southwest until 8.26 a. m. and from 7/10 to 10/10 A.-St., altitude 2,600 m., from the same direction thereafter. There were a few St. from the south-southeast after 11.13 p. m. Light rain began at 11.13 p. m.

Pressure was low over Wisconsin and high off the south Atlantic coast.

April 20.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 9,500 m.; at maximum altitude, 9,000 m.

There were 10/10 to 5/10 St. from the north before 11.20 a. m. at an altitude of 800 m. From 3/10 to 10/10 St.-Cu. were visible after 11.20 a. m. at an altitude of 2,500 m. These changed in direction from north to north-northwest.

Pressure was low off the New Jersey coast and high over the upper Missouri Valley.

April 21.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,800 m. There were 7/10 Ci.-St. from the west and a few Cu., apparently motionless.

Pressure was high over the Dakotas and low off the North Atlantic States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 22:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
3.37 p. m...	712.7	3.0	100	e.	6.7	526	712.7	3.0	100	e.	6.7
3.48 p. m...	712.7	3.0	100	e.	6.3	707	697.0	1.4	......	e.	....
4.50 p. m...	712.7	2.7	100	e.	6.3	829	686.5	0.8	......	e.	....
4.53 p. m...	712.7	2.6	100	e.	6.7	726	695.3	0.9	......	e.	....
4.56 p. m...	712.7	2.6	100	e.	6.7	526	712.7	2.6	100	e.	6.7
April 23:											
10.53 a. m....	720.7	1.8	90	nnw.	5.4	526	720.7	1.8	90	nnw.	5.4
11.57 a. m....	720.7	2.6	87	nnw.	5.4	1,147	667.1	− 2.2	......	nnw.	....
12.23 p. m...	720.7	3.7	85	nw.	6.7	1,901	606.3	− 6.0	......	n.	....
1.03 p. m...	720.6	4.3	79	nw.	6.7	2,441	565.7	− 9.5	......	n.	....
1.30 p. m...	720.8	5.1	79	nw.	7.2	2,596	554.7	− 7.9	......	n.	....
1.51 p. m...	720.9	5.1	75	nw.	7.2	3,001	526.4	−10.0	......	n.	....
1.56 p. m...	720.9	5.1	73	wnw.	6.3	2,762	542.9	− 8.6	......	n.	....
2.04 p. m...	720.9	5.2	74	nnw.	5.4	2,417	567.5	− 8.7	......	n.	....
2.18 p. m...	721.0	5.1	75	wnw.	4.9	1,735	619.5	− 5.5	......	nnw.	....
2.27 p. m...	721.0	5.0	72	nw.	5.8	1,103	670.9	− 2.1	......	nw.	....
2.32 p. m...	721.0	4.9	72	nw.	5.8	775	699.2	0.6	......	nw.	....
2.40 p. m...	721.0	5.0	72	nw.	5.8	526	721.0	5.0	72	nw.	5.8
Apr. 24:											
8.05 a. m....	722.9	3.2	69	nw.	8.5	526	722.9	3.2	69	nw.	8.5
8.15 a. m....	722.9	3.5	69	nw.	8.5	923	688.1	0.4	......	nnw.	....
8.36 a. m....	722.9	4.4	63	nw.	11.6	1,421	646.7	− 3.0	......	nnw.	....
8.42 a. m....	722.9	4.7	63	nw.	9.8	1,581	633.7	− 4.2	......	n.	....
8.49 a. m....	722.9	5.0	62	nw.	9.8	1,746	620.7	− 3.5	......	n.	....
8.53 a. m....	722.9	5.0	62	wnw.	10.3	2,166	588.7	− 4.9	......	n.	....
9.06 a. m....	722.9	5.0	62	wnw.	9.4	2,739	546.9	− 8.0	......	n.	....
9.27 a. m....	722.9	6.2	63	nw.	12.5	3,481	497.2	−11.2	......	n.	....
10.11 a. m....	722.9	7.0	52	nw.	10.3	4,510	434.2	−15.8	......	n.	....
10.56 a. m....	722 9	7.7	52	nw.	8.9	4,818	417.0	−18.0	......	n.	....
11.44 a. m....	722.9	8.3	45	nw.	8.5	5,676	372.1	−22.7	......	n.	....
1.07 p. m...	722.3	9.3	42	nnw.	6.7	4,594	430.1	−16.1	......	nne.	....
1.53 p. m...	722.0	10.5	42	nw.	7.2	3,686	484.9	−10.9	......	nne.	....
2.08 p. m...	721.8	10.7	40	nw.	8.5	2,595	557.8	− 7.4	......	nne.	....
2.13 p. m...	721.8	10.4	38	nnw.	8.5	2,318	577.8	− 3.5	......	nne.	....
2.20 p. m...	721.7	10.6	39	nnw.	7.2	1,945	605.7	− 3.5	......	n.	....
2.35 p. m...	721.6	11.0	34	nnw.	8.5	1,381	650.2	0.9	......	nnw.	....
2.46 p. m...	721.5	11.0	36	nw.	8.0	897	689.9	6.0	......	nnw.	....
2.51 p. m...	721.5	11.2	38	nnw.	8.5	526	721.5	11.2	38	nnw.	8.5

April 22.—Three kites were used; lifting surface, 19.4 sq. m. Wire out, 1,700 m.; at maximum altitude, 600 m.

There was dense fog except from 4.01 to 4.28 p. m., when the sky was covered with St. from the east and St.-Cu. from the west-northwest.

Pressure was low over Virginia and high over Minnesota.

April 23.—Six kites were used; lifting surface, 40.3 sq. m. Wire out, 4,750 m.; at maximum altitude, 3,550 m.

There were 7/10 to 10/10 St.-Cu. from the north. The head kite entered St.-Cu. at 11.15 a. m., and fell below it at 2.21 p. m.; altitudes, respectively, 950 and 1,400 m.

High pressure, central over Lake Superior, covered the northern and eastern United States.

April 24.—Nine kites were used; lifting surface, 57.2 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,800 m.

There were a few to 5/10 St.-Cu. from the north at an altitude of 1,500 m.

Pressure was high over Wisconsin and low south of Florida.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 25:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.42 a. m....	722.4	6.3	52	wnw.	5.4	526	722.4	6.3	52	wnw.	5.4
6.51 a. m....	722.5	6.4	51	wnw.	5.4	637	712.8	7.9	......	nw.	....
7.23 a. m....	722.5	7.1	54	wnw.	5.8	910	689.7	7.7	......	nnw.	....
7.33 a. m....	722.6	7.3	50	wnw.	5.8	1,544	638.4	2.3	......	nnw.	....
8.07 a. m....	722.6	7.9	48	wnw.	7.2	1,979	604.6	0.0	......	n.	....
9.15 a. m....	722.7	10.0	42	nw.	7.6	2,856	541.7	− 5.3	......	n.	....
9.32 a. m....	722.6	10.4	44	nw.	8.0	1,642	630.6	1.6	......	n.	....
9.40 a. m....	722.6	10.7	45	nw.	7.6	1,311	656.8	3.6	......	nnw.	....
10.01 a. m....	722.6	11.2	44	nw.	7.6	744	704.0	8.5	......	nw.	....
10.09 a. m....	722.6	11.7	43	nw.	7.6	526	722.6	11.7	43	nw.	7.6
Apr. 26:											
1.20 p. m...	724.9	17.9	29	e.	4.9	526	724.9	17.9	29	e.	4.9
1.41 p. m...	724.8	18.2	32	ese.	3.8	2,742	555.0	0.7	......	calm.	....
1.52 p. m...	724.8	18.4	30	ese.	3.1	2,190	594.2	3.8	......	calm.	....
2.05 p. m...	724.7	18.0	29	se.	4.5	1,590	638.9	9.7	......	calm.	....
2.16 p. m...	724.7	18.0	30	ese.	5.4	941	690.3	14.5	......	se.	....
2.25 p. m...	724.6	18.0	29	se.	4.5	526	724.6	18.0	29	se.	4.5
Apr. 27:											
11.44 a. m....	728.2	19.2	29	sse.	6.3	526	728.2	19.2	29	sse.	6.3
11.53 a. m....	728.1	18.9	32	sse.	9.8	925	694.8	14.1	......	s.	....
12.05 p. m...	728.1	18.5	29	sse.	10.7	1,350	660.6	10.3	......	s.	....
12.16 p. m...	728.0	19.2	27	sse.	8.9	1,588	641.8	7.8	......	s.	....
12.36 p. m...	727.8	19.4	29	sse.	8.9	2,081	604.4	4.5	......	s.	....
1.08 p. m...	727.5	19.8	29	sse.	10.7	2,531	571.6	3.7	......	s.	....
2.02 p. m...	727.1	19.6	31	sse.	7.2	1,964	612.3	4.9	......	s.	....
2.12 p. m...	727.0	19.4	30	sse.	8.5	1,578	641.8	7.4	......	sse.	....
2.22 p. m...	726.9	19.4	30	sse.	8.0	1,290	664.2	10.3	......	sse.	....
2.34 p. m...	726.8	19.2	30	sse.	8.9	780	705.6	15.0	......	sse.	....
2.44 p. m...	726.7	19.4	31	sse.	8.9	526	726.7	19.4	31	sse.	8.9

April 25.—Seven kites were used; lifting surface, 44.6 sq. m. Wire out, 5,000 m.; at maximum altitude, 3,500 m.

The sky was cloudless.

A large area of high pressure, central over the lake region, covered the country east of the Rocky Mountains.

April 26.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,500 m.

The sky was cloudless, with light haze in southwest at commencement of flight. There were a few light Cu. in the southwest at the end of flight.

Pressure was high over the lower lake region and low over the west Gulf coast.

April 27.—Five kites were used; lifting surface, 34.0 sq. m. Wire out, 3,500 m.; at maximum altitude, 3,400 m.

There were 5/10 Ci.-St. from the west and from a few to 4/10 A.-Cu. from the west-southwest. A halo was observed.

Pressure was high over the Middle Atlantic Coast States and low over Montana.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Apr. 28:											
Kite flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.21 p. m....	724.0	19.8	43	se.	3.6	526	724.0	19.8	43	se.	3.6
1.30 p. m....	723.9	19.7	43	sw.	4.0	1,018	683.4	14.2	......	sw.	....
1.55 p. m....	723.6	19.1	43	nw.	5.4	526	723.6	19.1	43	nw.	5.4
Balloon ascension—											
3.59 p. m....	722.8	18.8	52	sw.	2.2	526	722.8	18.8	52	sw.	2.2
4.09 p. m....	722.8	19.0	50	sw.	2.7	2,714	555.2	0.5	......	ssw.	....
4.22 p. m....	722.7	18.8	50	ssw.	3.6	1,721	627.2	7.1	......	ssw.	....
4.31 p. m....	722.6	19.0	50	s.	4.9	1,292	660.3	10.9	......	ssw.	....
4.43 p. m....	722.6	18.4	50	ssw.	5.4	526	722.6	18.4	50	ssw.	5.4
Apr. 29:											
10.11 a. m....	719.0	17.6	60	w.	2.2	526	719.0	17.6	60	w.	2.2
10.35 a. m....	718.9	18.5	59	w.	2.2	1,974	605.0	7.7	......	calm.	....
10.45 a. m....	718.8	19.0	60	w.	1.8	1,529	638.4	10.3	......	calm.	....
10.58 a. m....	718.7	18.7	60	w.	2.7	885	689.2	13.7	......	calm.	....
11.07 a. m....	718.7	19.2	58	w.	1.8	526	718.7	19.2	58	w.	1.8
Apr. 30:											
8.04 a. m....	712.3	14.8	92	se.	2.7	526	712.3	14.8	92	se.	2.7
8.15 a. m....	712.3	15.0	92	ese.	2.7	1,794	612.7	9.2	......	sw.	....
8.27 a. m....	712.3	14.8	92	ese.	3.6	867	684.3	14.7	......	ssw.	....
8.49 a. m....	712.3	14.5	94	se.	2.9	526	712.3	14.5	94	se.	2.9

April 28.—Kite flight: One kite was used; lifting surface, 8.3 sq. m. Wire out, 500 m., at maximum altitude.

There were 2/10 Ci.-St. from the west and 7/10 Cu. from the south-southwest. Strong ascending currents prevailed.

Balloon ascension: One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,600 m.

There were 3/10 Ci.-St. from the west and 7/10 Cu. from the south-southwest; altitude of Cu., 2,000 m.

High pressure, central over the middle Atlantic coast, covered the country east of the Rocky Mountains.

April 29.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,800 m.

There were 7/10 to 4/10 A.-Cu. from the northwest and 1/10 to 4/10 St.-Cu. from the same direction after 10.46 a. m.

Pressure was high over the Carolinas and low over Kansas.

April 30.—One captive balloon was used, capacity 22.4 cu. m. Wire out, 2,400 m.

There were 10/10 A.-St. from the southwest throughout the flight, and light fog from 7.55 to 8.13 a. m. and at short intervals thereafter.

A low pressure area, with centers over Texas, Missouri, and lower Michigan, covered the central and eastern portion of the country.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 1:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.13 p. m....	708.4	23.8	62	ssw.	6.0	526	708.4	23.8	62	ssw.	6.0
1.16 p. m....	708.4	23.8	62	ssw.	6.3	767	689.1	20.9	......	ssw.	....
1.55 p. m....	708.0	24.7	54	ssw.	7.4	1,320	645.8	15.5	......	sw.	....
2.07 p. m....	707.8	25.0	50	ssw.	7.2	1,773	612.1	11.5	......	sw.	....
2.23 p. m....	707.6	25.0	49	ssw.	5.8	2,663	549.7	6.9	......	sw.	....
2.38 p. m....	707.5	25.7	51	ssw.	7.6	3,211	514.1	4.0	......	sw.	....
3.01 p. m....	707.2	24.8	53	ssw.	8.9	3.933	469.9	− 0.9	......	sw.	....
3.37 p. m....	706.7	24.0	53	s.	13.6	3,236	512.2	2.8	......	sw.	....
4.01 p. m....	706.5	23.6	56	s.	12.6	2,573	555.2	7.2	......	sw.	....
4.35 p. m....	706.4	24.4	55	s.	12.7	1,857	604.9	13.1	......	sw.	....
4.45 p. m....	706.4	24.6	53	s.	15.0	1,230	651.2	16.8	......	ssw.	....
4.53 p. m....	706.3	24.4	55	s.	11.6	938	673.0	19.6	......	s.	....
5.01 p. m....	706.3	24.2	51	s.	9.4	526	706.3	24.2	51	s.	9.4
May 2:											
1.33 p. m....	712.6	8.6	55	nw.	17.9	526	712.6	8.6	55	nw.	17.9
1.42 p. m....	712.6	9.2	58	nw.	17.9	941	677.5	4.0	......	nw.	....
1.58 p. m....	712.7	9.4	53	nw.	21.5	1,461	635.5	− 0.3	......	wnw.	....
2.06 p. m....	712.7	8.9	55	nw.	22.4	1,624	622.5	− 1.4	......	wnw.	....
2.10 p. m....	712.7	8.8	55	nw.	18.8	1,866	603.9	2.8	......	wnw.	....
2.25 p. m....	712.7	8.6	58	nw.	17.0	2,721	543.2	− 0.9	......	w.	....
2.55 p. m....	712.7	8.2	58	nw.	16.1	3,390	499.1	− 5.2	......	w.	....
3.28 p. m....	712.7	7.7	59	wnw.	17.0	2.558	554.2	0.6	......	w.	....
3.40 p. m....	712.7	7.8	56	wnw.	16.1	2,146	583.3	3.0	......	w.	....
3.57 p. m....	712.7	7.8	56	nw.	15.6	1,546	628.4	− 0.5	......	wnw.	....
4.07 p. m....	712.7	7.6	58	nw.	16.5	1,337	644.9	0.6	......	nw.	....
4.19 p. m....	712.7	7.2	57	nw.	20.6	856	684.5	2.7	......	nw.	....
4.23 p. m....	712.7	6.8	58	nw.	21.5	526	712.7	6.8	58	nw.	21.5
May 3:											
6.38 a. m....	717.8	2.4	65	wnw.	7.2	526	717.8	2.4	65	wnw.	7.2
6.46 a. m....	717.9	2.8	66	wnw.	7.2	975	678.8	− 2.2	......	wnw.	....
7.02 a. m....	718.0	2.9	66	wnw.	7.6	1,784	612.7	− 6.6	......	wnw.	....
7.21 a. m....	718.0	3.0	69	wnw.	8.9	2,408	565.3	−10.8	......	nw.	....
7.25 a. m....	718.0	3.2	69	wnw.	8.0	2,758	540.4	− 6.8	......	nw.	....
7.48 a. m....	718.1	3.4	73	wnw.	11.2	3,331	502.3	− 7.2	......	nw.	....
8.03 a. m....	718.1	3.3	76	wnw.	9.8	3,817	471.7	− 9.9	......	nw.	....
8.40 a. m....	718.2	3.4	79	wnw.	10.3	4,300	443.0	−14.0	......	nw.	....
9.00 a. m....	718.3	3.8	76	wnw.	10.3	4,823	414.3	−17.2	......	nw.	....
10.16 a. m....	718.2	4.5	76	wnw.	6.7	4,327	443.0	−13.0	......	nw.	....
10.41 a. m....	718.1	5.5	76	wnw.	10.7	3,844	471.7	−10.0	......	nw.	....
11.18 a. m....	718.0	6.2	66	wnw.	15.2	3,300	506.0	− 6.9	......	nw.	....
11.38 a. m....	717.9	6.7	68	wnw.	13.0	2,567	555.8	− 5.6	......	nw.	....
11.45 a. m....	717.8	7.0	71	wnw.	14.3	2,254	578.6	− 7.5	......	nw.	....
11.56 a. m....	717.7	6.8	66	wnw.	13.0	1,664	623.6	− 4.6	......	wnw.	....
12.10 p. m...	717.7	7.4	68	wnw.	12.1	1,027	675.0	1.8	......	wnw.	....
12.20 p. m...	717.7	7.2	61	wnw.	12.5	526	717.7	7.2	61	wnw.	12.5

May 1.—Five kites were used; lifting surface, 32.0 sq. m. Wire out, 5,500 m.; at maximum altitude, 5,200 m.

There were from 3/10 to 9/10 St.-Cu. from the southwest at an altitude of about 2,700 m.

Pressure was low over southern Michigan and high over southern Florida.

May 2.—Five kites were used; lifting surface, 27.0 sq. m. Wire out, 6,000 m., at maximum altitude.

There were 1/10 to 4/10 St.-Cu. from the west-northwest at an altitude of 1,900 m.

Pressure was low over New Brunswick and high over Kansas.

May 3.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,900 m.

There were 7/10 to 9/10 St.-Cu. from the west-northwest at an altitude of 1,800 m.

High pressure, central over Iowa, covered the Middle and Southern States; low pressure was central over the Gulf of St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 4:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
11.25 a. m....	720.8	10.4	64	nw.	7.6	526	720.8	10.4	64	nw.	7.6
11.37 a. m....	720.8	10.3	71	nw.	6.3	834	694.5	7.7	......	nw.	....
12.02 p. m....	720.8	10.9	63	nw.	5.8	1,459	643.7	2.6	......	nw.	....
12.32 p. m....	720.8	12.3	56	nw.	7.2	1,099	672.9	7.3	......	nw.	....
12.41 p. m....	720.8	12.6	56	w.	7.2	526	720.8	12.6	56	w.	7.2
May 5:											
1.13 p. m....	725.0	11.9	34	wnw.	3.6	526	725.0	11.9	34	wnw.	3.6
1.25 p. m....	725.1	13.4	32	wnw..	2.7	2,385	576.6	− 4.6	......	n.	....
1.30 p. m....	725.1	13.8	27	wnw.	5.4	2,159	593.4	− 3.6	......	nw.	....
1.33 p. m....	725.1	13.8	27	wnw.	5.4	1,832	618.3	− 0.6	......	nw.	....
1.42 p. m....	725.1	13.4	24	wnw.	7.2	1,220	666.9	4.7	......	nw.	....
1.58 p. m....	725.2	12.8	21	nw.	8.0	526	725.2	12.8	21	nw.	8.0
May 6:											
1.12 p. m....	723.2	15.5	30	nw.	3.6	526	723.2	15.5	30	nw.	3.6
1.35 p. m....	723.1	16.4	29	w.	4.0	3,254	517.1	− 5.6	......	nw.	....
1.47 p. m....	723.1	17.0	30	nw.	3.1	2,717	553.5	− 3.4	......	wnw.	....
1.57 p. m....	723.1	16.0	29	nw.	3.1	2,213	589.6	0.8	......	calm.	....
2.03 p. m....	723.1	16.0	29	nnw.	3.1	1,667	630.7	5.5	......	calm.	....
2.17 p. m....	723.1	17.0	27	nnw.	4.9	994	684.1	10.7	......	n.	....
2.25 p. m....	723.1	16.4	26	nw.	4.0	526	723.1	16.4	26	nw.	4.0
May 7:											
1.09 p. m....	723.7	19.2	22	nw.	5.8	526	723.7	19.2	22	nw.	5.8
1.23 p. m....	723.7	19.3	25	nnw.	5.8	2,185	593.6	3.3	......	ne.	....
1.39 p. m....	723.6	19.3	24	nnw.	4.9	1,607	636.7	7.8	......	ne.	....
1.51 p. m....	723.6	19.9	25	nnw.	5.4	1,466	647.6	10.0	......	ne.	....
2.00 p. m....	723.6	19.7	24	nnw.	4.9	882	694.1	14.8	......	nnw.	....
2.10 p. m....	723.5	19.4	25	nnw.	3.1	526	723.5	19.4	25	nnw.	3.1

May 4.—Three kites were used; lifting surface, 21.4 sq. m. Wire out, 1,200 m., at maximum altitude.

There were 2/10 to 4/10 Ci.-St. from the west-southwest and 4/10 St.-Cu. from the west-northwest.

Pressure was low over the Gulf of St. Lawrence and high over the upper Mississippi Valley.

May 5.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,600 m.

There were a few Cu., direction not apparent.

Pressure was high over the Ohio Valley and low over the Gulf of St. Lawrence.

May 6.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,900 m.

There were a few St.-Cu. from the northwest.

Pressure was high over the Ohio Valley and low over Saskatchewan.

May 7.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,500 m.

There were 4/10 to 7/10 A.-St. from the south-southeast.

Pressure was low over the Gulf of St. Lawrence and high over Ohio.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 8:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7.53 a. m....	718.5	15.6	36	nne.	8.0	526	718.5	15.6	36	nne.	8.0
8.01 a. m....	718.5	15.4	36	nne.	7.2	1,033	676.8	14.0	......	ne.	....
8.11 a. m....	718.5	15.1	36	nne.	7.2	1,699	625.1	8.8	......	ene.	....
8.23 a. m....	718.4	14.7	40	nne.	6.7	2,186	589.1	4.6	......	ene.	....
8.34 a. m....	718.4	15.4	38	nne.	7.2	2,471	569.0	1.0	......	ene.	....
8.44 a. m....	718.3	15.2	40	n.	6.7	2,936	536.6	−2.5	......	ene.	....
9.07 a. m....	718.3	15.2	37	ne.	6.7	3,636	490.8	−7.5	......	ene.	....
9.10 a. m....	718.2	15.3	37	ne.	6.7	3,855	477.4	−4.2	......	ene.	....
9.20 a. m....	718.0	15.4	37	ne.	6.3	3,949	471.6	−4.0	......	ene.	....
9.30 a. m....	717.8	16.0	38	ne.	5.4	4,172	458.2	−5.3	......	ene.	....
10.08 a. m....	717.3	16.1	38	e.	5.8	3,710	485.0	−2.3	......	ene.	....
10.29 a. m....	717.2	15.7	39	ne.	6.7	3,464	500.2	−2.5	......	ene.	....
10.31 a. m....	717.2	15.6	39	ne.	6.7	3,340	507.8	−5.5	......	ene.	....
10.45 a. m....	717.1	15.5	39	ne.	4.9	2,782	544.2	−2.0	......	ene.	....
11.03 a. m....	717.1	15.6	38	ne.	5.4	2,206	585.5	3.7	......	ene.	....
11.21 a. m....	716.9	15.2	40	ene.	7.6	1,523	636.0	7.3	......	ene.	....
11.30 a. m....	716.8	14.5	49	ene.	6.3	938	682.5	8.5	......	ene.	....
11.35 a. m....	716.8	13.6	54	ene.	6.3	526	716.8	13.6	54	ene.	6.3
May 9:											
8.05 a. m....	711.0	10.6	73	wnw.	8.9	526	711.0	10.6	73	wnw.	8.9
8.10 a. m....	710.9	10.4	75	wnw.	8.0	997	671.9	12.2	......	nnw.	....
8.46 a. m....	710.7	11.4	71	wnw.	6.7	1,265	650.7	10.1	......	n.	....
8.58 a. m....	710.6	11.6	68	wnw.	6.3	1,930	600.3	5.6	......	n.	....
9.20 a. m....	710.5	11.8	67	w.	7.6	2,685	547.0	0.0	......	n.	....
9.49 a. m....	710.3	13.2	60	w.	9.8	3,349	503.0	−5.1	......	n.	....
10.10 a. m....	710.2	14.4	56	w.	8.0	3,748	478.1	−7.8	......	n.	....
10.43 a. m....	710.1	16.3	52	wnw.	8.9	4,033	461.0	−7.4	......	n.	....
10.58 a. m....	710.0	16.8	53	wnw.	8.9	4,588	430.3	−9.7	......	n.	....
11.08 a. m....	710.0	17.5	53	wnw.	8.5	4,414	439.9	−8.6	......	n.	....
11.22 a. m....	710.0	18.2	51	nw.	10.3	4,286	447.5	−8.7	......	n.	....
11.43 a. m....	709.9	19.5	43	wnw.	7.6	3,865	472.4	−6.2	......	n.	....
12.05 p. m...	709.9	20.3	37	nw.	10.7	3,311	506.8	−3.5	......	n.	....
12.22 p. m...	709.8	21.6	36	nw.	10.3	2,505	560.4	2.4	......	n.	....
12.34 p. m...	709.7	21.2	33	nw.	10.3	2,191	582.5	4.6	......	nnw.	....
12.48 p. m...	709.6	20.6	35	nw.	10.7	1,794	611.1	8.7	......	nnw.	....
12.59 p. m...	709.5	20.8	34	wnw.	11.6	1,242	652.7	13.6	......	nnw.	....
1.05 p. m...	709.5	21.4	32	nnw.	11.6	1,019	670.0	15.9	......	nnw.	....
1.16 p. m...	709.4	21.0	40	wnw.	10.7	526	709.4	21.0	40	wnw.	10.7

May 8.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7,500 m.; at maximum altitude, 7,000 m.

The sky was overcast with A.-St. from the east-northeast at an altitude of 3,600 m. Light rain fell from 9.12 to 9.25 a. m. and from 11.15 a. m. until after the close of the flight.

Pressure was high over the Gulf States and low off the coast of Virginia and North Carolina.

May 9.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,700 m.

There were 9/10 to 10/10 A.-St. from the north-northwest, altitude, 2,600 m. Light rain fell from 8.11 to 8.14 a. m.

Pressure was high along the coast of the Gulf of Mexico and low over the Gulf of St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m. Pressure.	Temperature.	Rel. hum.	Wind. Direction.	Wind. Velocity.	At different heights above sea. Height.	Pressure.	Temperature.	Rel. hum.	Wind. Direction.	Wind. Velocity.
1911.											
May 10:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
3.51 p. m.	713.0	25.4	39	se.	6.3	526	713.0	25.4	39	se.	6.3
4.27 p. m.	713.0	25.3	35	se.	6.3	941	680.1	21.7	......	sse.	......
5.37 p. m.	713.1	24.8	36	se.	7.6	1,369	647.2	17.8	......	s.	......
6.23 p. m.	713.2	24.0	39	sse.	4.5	2,292	579.9	7.8	......	wsw.	......
6.30 p. m.	713.2	24.0	38	sse.	4.5	1,989	601.1	10.6	......	wsw.	......
6.40 p. m.	713.3	24.0	38	sse.	4.5	1,264	655.1	16.9	......	sw.	......
6.49 p. m.	713.3	23.8	40	sse.	4.5	918	682.0	20.3	......	s.	......
6.54 p. m.	713.4	23.7	38	se.	4.5	526	713.4	23.7	38	se.	4.5
May 11:											
6.19 a. m.	714.2	22.5	48	wsw.	7.2	526	714.2	22.5	48	wsw.	7.2
6.25 a. m.	714.3	22.7	47	wsw.	7.2	979	678.3	23.9	45	wsw.	9.4
6.39 a. m.	714.4	23.1	45	wsw.	6.3	1,300	653.9	21.0	45	wsw.	11.2
7.17 a. m.	714.7	23.7	45	wsw.	6.3	1,931	607.9	14.4	51	wsw.	10.5
8.01 a. m.	714.9	23.8	45	wsw.	8.0	2,394	575.6	11.2	48	wsw.	8.3
9.06 a. m.	715.3	24.8	44	wsw.	5.8	2,773	550.8	8.6	44	wsw.	10.3
9.20 a. m.	715.4	25.1	42	wsw.	6.3	3,680	493.5	−0.4	42	sw.	11.4
9.30 a. m.	715.6	25.6	42	wsw.	6.3	2,897	542.0	6.2	42	sw.	9.4
9.49 a. m.	715.7	26.0	40	w.	6.3	2,120	595.2	12.1	41	wsw.	11.2
10.06 a. m.	715.8	26.4	38	w.	5.8	1,434	645.2	18.2	49	w.	8.0
10.16 a. m.	715.9	27.0	37	w.	5.4	784	695.3	24.4	48	w.	7.0
10.21 a. m.	715.9	27.0	35	w.	5.8	526	715.9	27.0	35	w.	5.8
May 12:											
11.30 a. m.	718.6	27.6	27	w.	5.8	526	718.6	27.6	27	w.	5.8
11.40 a. m.	718.5	27.7	28	sw.	5.8	1,421	648.9	18.1	30	w.	3.5
11.43 a. m.	718.5	27.7	28	sw.	4.0	933	686.2	22.7	34	w.	3.5
11.58 a. m.	718.4	28.0	26	w.	7.2	526	718.4	28.0	26	w.	7.2

May 10.—Five kites were used; lifting surface, 36.9 sq. m. Wire out, 3,600 m.; at maximum altitude, 2,100 m.

There were a few to 7/10 St.-Cu. from the west-southwest.

Pressure was high over the Florida Gulf coast and low off the coast of Nova Scotia.

May 11.—Six kites were used; lifting surface, 38.8 sq. m. Wire out, 5,800 m.; at maximum altitude, 4,700 m.

There were a few Ci. from the southwest.

Pressure was high off the Atlantic coast and a large low was central just north of Lake Superior.

May 12.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m.

There were 2/10 Cu. and St.-Cu. from the southwest at the beginning of flight, and 3/10 Ci.-Cu. and Ci.-St., and 2/10 Cu. from the west during the latter part of the flight.

Pressure was low north of the Great Lakes and high off the south Atlantic coast and in the upper Missouri Valley.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 12:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
3.03 p. m.	....	....	....	....	....	526	....	....	....	s.	5.4
3.04 p. m.	....	....	....	....	....	706	....	....	....	s. 15 e.	5.8
3.05 p. m.	....	....	....	....	....	886	....	....	....	s. 13 w.	3.3
3.06 p. m.	....	....	....	....	....	1,066	....	....	....	s. 30 w.	3.2
3.07 p. m.	....	....	....	....	....	1,246	....	....	....	s. 49 w.	2.8
3.08 p. m.	....	....	....	....	....	1,426	....	....	....	s. 49 w.	3.8
3.09 p. m.	....	....	....	....	....	1,606	....	....	....	s. 50 w.	3.5
3.10 p. m.	....	....	....	....	....	1,786	....	....	....	s. 53 w.	3.6
3.11 p. m.	....	....	....	....	....	1,966	....	....	....	s. 53 w.	4.0
3.12 p. m.	....	....	....	....	....	2,146	....	....	....	s. 53 w.	3.2
3.13 p. m.	....	....	....	....	....	2,326	....	....	....	s. 62 w.	3.8
3.14 p. m.	....	....	....	....	....	2,506	....	....	....	s. 68 w.	4.5
3.14-40 p.m.	....	....	....	....	....	2,626	....	....	....	s. 58 w.	5.7
May 13:											
6.32 a. m.	720.4	17.8	59	nw.	7.6	526	720.4	17.8	59	nw.	7.6
6.38 a. m.	720.4	17.8	59	nw.	8.0	924	687.6	15.8	61	nw.	13.6
6.47 a. m.	720.4	17.8	60	nw.	7.2	1,407	649.4	12.4	47	nw.	13.6
7.04 a. m.	720.5	18.0	59	nw.	7.2	2,194	591.2	8.5	42	wnw.	12.3
7.22 a. m.	720.6	18.0	60	nw.	7.2	2,810	548.6	3.0	65	w.	15.6
7.31 a. m.	720.7	17.8	60	nw.	7.6	3,488	504.1	− 2.2	66	w.	13.6
7.57 a. m.	720.8	17.8	60	nw.	8.9	3,969	474.6	− 5.8	60	w.	15.6
8.19 a. m.	720.8	17.8	62	nw.	10.3	4,267	457.0	− 6.5	47	w.	14.1
9.13 a. m.	720.8	18.6	62	nw.	7.2	4,715	431.2	−11.7	41	wnw.	11.0
9.32 a. m.	720.9	18.6	63	nw.	7.2	3,882	480.3	− 5.4	41	wnw.	8.8
9.57 a. m.	720.9	18.6	54	nw.	6.3	2,841	546.9	4.8	39	wnw.	6.9
10.06 a. m.	720.9	19.0	54	nw.	6.3	2,262	586.8	9.1	21	wnw.	10.5
10.21 a. m.	720.9	19.0	51	nw.	5.4	1,526	640.9	11.4	15	wnw.	10.4
10.40 a. m.	721.0	19.4	51	nw.	5.4	526	721.0	19.4	51	nw.	5.4
May 14:											
1.17 p. m.	724.4	18.2	48	e.	6.0	526	724.4	18.2	48	e.	6.0
1.41 p. m.	724.3	18.8	48	se.	6.3	785	702.7	15.0	55	se.	6.9
1.52 p. m.	724.2	18.3	46	se.	7.7	1,051	680.8	13.1	60	se.	6.2
3.03 p. m.	723.8	19.4	47	se.	6.0	1,413	651.8	11.6	58	sse.	3.6
3.31 p. m.	723.8	19.6	45	ese.	6.0	526	723.8	19.6	45	ese.	6.0
May 15:											
12.54 p. m.	721.5	20.6	47	sse.	6.7	526	721.5	20.6	47	sse.	6.7
3.52 p. m.	719.8	23.2	42	sse.	7.2	1,905	613.6	13.8	32	sw.	3.4
4.04 p. m.	719.6	23.3	43	sse.	7.6	1,410	650.0	19.2	38	sw.	4.3
4.18 p. m.	719.4	23.2	43	sse.	7.6	927	687.0	20.6	31	s.	6.0
4.26 p. m.	719.4	23.2	43	sse.	6.3	526	719.4	23.2	43	sse.	6.3

May 12.—One pilot balloon was used; ascensional force, 200 g.

There were 2/10 Ci.-St. from the west and 7/10 Cu. from the southwest; altitude of Cu., 2,600 m.

May 13.—Nine kites were used; lifting surface, 57.7 sq. m. Wire out, 8,800 m.; at maximum altitude, 6,800 m.

There were 10/10 A.-St. and Ci.-St., both from the west. A halo was observed.

Pressure was high over the upper Lakes and low off the Gulf of St. Lawrence.

May 14.—Four kites were used; lifting surface, 30.6 sq. m. Wire out, 2,200 m.; at maximum altitude, 1,600 m.

The sky was cloudless. There was a light haze.

Pressure was low over the upper Missouri Valley and the West Indies and high over the St. Lawrence Valley.

May 15.—Six kites were used; lifting surface, 40.8 sq. m. Wire out, 3,700 m.; at maximum altitude, 2,100 m.

There were 6/10 to 7/10 Ci.-St. from the southwest.

Pressure was high over the middle Atlantic and New England coast and low over southern Florida and over Ontario.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 16:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.23 a. m....	718.2	20.4	43	w.	10.3	526	718.2	20.4	43	w.	10.3
6.32 a. m....	718.2	20.4	42	w.	9.8	889	688.8	22.3	43	wnw.	6.5
6.44 a. m....	718.3	20.4	45	w.	9.8	1,485	643.1	17.2	50	wnw.	12.4
6.58 a. m....	718.3	20.8	43	w.	9.8	1,889	613.4	13.6	55	wnw.	11.2
7.13 a. m....	718.3	20.4	45	w.	9.8	2,526	568.5	8.2	66	wnw.	9.8
7.33 a. m....	718.3	20.0	48	w.	8.9	2,899	543.1	4.1	79	wnw.	7.0
8.38 a. m....	718.3	22.1	46	w.	8.9	2,645	560.5	5.9	98	wnw.	8.2
9.30 a. m....	718.3	22.6	46	w.	9.4	3,723	490.9	0.3	70	wnw.	8.3
9.41 a. m....	718.3	23.2	44	w.	9.4	4,546	442.9	−4.2	40	w.	11.8
9.51 a. m....	718.3	23.5	46	w.	8.9	4,365	453.0	−2.7	36	w.	12.3
10.10 a. m....	718.3	24.2	47	w.	7.6	3,324	515.8	1.3	23	w.	5.8
10.22 a. m....	718.3	24.3	46	w.	8.0	2,540	567.6	9.1	32	wnw.	4.2
11.05 a. m....	718.2	26.2	35	nw.	8.9	2,158	594.4	12.3	32	w.	9.4
11.20 a. m....	718.2	26.4	36	nw.	10.7	1,565	637.4	17.0	64	w.	13.9
11.30 a. m....	718.1	26.1	36	wnw.	8.0	1,295	657.5	19.0	62	wnw.	11.0
11.37 a. m....	718.1	26.4	38	wnw.	7.2	867	690.8	22.7	59	wnw.	8.3
11.43 a. m....	718.1	26.4	37	wnw.	6.3	526	718.1	26.4	37	wnw.	6.3
May 17:											
11.44 a. m....	718.0	26.7	44	nw.	3.4	526	718.0	26.7	44	nw.	3.4
11.50 a. m....	718.0	26.5	43	nnw.	3.8	1,357	653.0	19.5	43	nw.	....
12.30 p. m....	717.7	27.9	40	nw.	4.9	526	717.7	27.9	40	nw.	4.9
May 18:											
8.01 a. m....	715.8	24.2	52	w.	5.4	526	715.8	24.2	52	w.	5.4
8.08 a. m....	715.8	24.0	55	w.	5.4	907	685.5	22.6	41	wnw.	6.0
8.22 a. m....	715.8	24.2	55	w.	5.8	1,100	665.8	20.5	41	wnw.	6.3
8.41 a. m....	715.8	24.2	50	w.	6.7	1,440	644.6	17.9	48	wnw.	6.3
9.08 a. m....	715.8	25.6	46	w.	6.7	1,922	609.2	13.1	60	wnw.	6.5
9.30 a. m....	715.8	26.2	46	w.	6.3	2,356	578.7	9.3	61	wnw.	6.5
10.03 a. m....	715.8	26.0	48	w.	6.3	3,203	521.8	1.8	68	wnw.	....
10.30 a. m....	715.6	27.2	46	wnw.	6.3	3,399	509.0	− 0.3	77	wnw.	7.2
10.58 a. m....	715.3	27.5	46	w.	5.8	3,864	480.2	− 3.2	53	wnw.	....
12.15 p. m....	714.6	29.3	37	wnw.	5.8	526	714.6	29.3	37	wnw.	5.8

May 16.—Nine kites were used; lifting surface, 57.2 sq. m. Wire out, 9,100 m.; at maximum altitude, 8,000 m.

There were from 8/10 to 10/10 Ci.-St. and A.-Cu., both from the west. A halo was observed.

Pressure was high off the south Atlantic coast and over Ontario and low off Nova Scotia.

May 17.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

Haze prevailed. There were 2/10 to 7/10 Ci.-St. from the west-northwest.

Pressure was high over New York and the South Atlantic States and relatively low over northern Virginia.

May 18.—Seven kites were used; lifting surface, 46.6 sq. m. Wire out, 6,400 m.; at maximum altitude, 5,500 m.

There were 5/10 to 1/10 A.-St. from the northwest until 10.50 a. m. and a few to 3/10 Cu. from the west-northwest after 10.50 a. m.

Pressure was high over Georgia and low over Alberta.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 19:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
9.46 a. m....	715.1	28.0	51	nnw.	1.8	526	715.1	28.0	51	nnw.	1.8
9.56 a. m....	715.1	28.3	54	calm.	0.0	2,655	558.9	13.1	52	w.	2.5
10.13 a. m....	715.1	28.0	54	calm.	0.0	1,536	637.5	18.5	55	nw.	2.5
10.38 a. m....	715.0	29.4	41	se.	4.0	940	682.5	24.6	52	calm.	0.0
10.49 a. m....	715.0	29.8	42	ese.	3.6	526	715.0	29.8	42	ese.	3.6
May 20:											
8.17 a. m....	716.9	23.8	71	ese.	2.2	526	716.9	23.8	71	ese.	2.2
8.29 a. m....	716.9	23.6	74	e.	2.2	1,863	614.2	16.7	......	sw.	4.5
8.34 a. m....	717.0	23.4	74	e.	2.2	1,431	645.9	17.9	12	ssw.	4.5
8.57 a. m....	717.0	24.4	71	ese.	2.7	1,015	677.9	20.8	32	wsw.	4.5
9.15 a. m....	717.0	24.4	71	ese.	3.1	714	701.8	21.4	39	....	....
9.18 a. m....	717.0	24.4	74	ese.	3.1	526	717.0	24.4	74	ese.	3.1
May 21:											
8.04 a.m....	718.6	23.4	78	ese.	2.7	526	718.6	23.4	78	ese.	2.7
8.15 a.m....	718.6	23.4	78	ese.	2.7	1,889	613.7	14.2	20	ssw.	5.7
8.27 a.m....	718.6	23.3	77	ese.	2.7	1,296	657.8	17.6	33	s.	2.5
8.55 a.m....	718.6	23.7	76	ese.	3.1	967	683.3	22.9	33	calm.	0.8
9.03 a.m....	718.6	24.3	74	ese.	2.7	526	718.6	24.3	74	ese.	2.0
May 22:											
1.17 p. m...	718.6	29.4	51	s.	6.7	526	718.6	29.4	51	s.	6.7
1.36 p. m...	718.5	28.5	51	s.	5.1	1,753	623.9	15.4	71	se.	....
1.39 p. m...	718.4	29.0	50	se.	6.3	1,592	635.9	16.7	80	se.	....
1.52 p. m...	718.4	29.4	49	....	4.7	1,114	672.1	22.1	86	sse.	....
2.22 p. m...	718.1	29.8	49	sse.	3.1	526	718.1	29.8	49	sse.	3.1

May 19.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,800 m. There were a few Cu. from the west-northwest and light haze.

Pressure was low over Manitoba and high off the coast of Nova Scotia.

May 20.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,500 m. The sky was cloundless, but there was light haze.

Pressure was high off the coast of Nova Scotia and a trough of low pressure extended from the upper Lakes to Texas.

May 21.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 3,000 m. The sky was cloudless, but there was light haze.

Low pressure was central over Iowa and Missouri and high pressure off the middle Atlantic coast.

May 22.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,400 m. There were 3/10 Cu. from the southeast.

Pressure was low over Kansas and high off the Atlantic coast.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 23:											
Balloon ascension—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
9.34 a. m....	718.7	27.0	60	se.	1.8	526	718.7	27.0	60	se.	1.8
10.23 a m....	718.7	28.2	55	se.	2.2	2,129	596.6	12.4	94	se.	1.0
10.38 a m....	718.7	28.6	52	se.	3.1	1,308	657.0	17.9	95	se.	2.2
10.46 a m....	718.7	28.5	51	se.	3.6	857	692.3	21.5	87	s.	3.1
11.05 a. m....	718.6	28.2	50	se.	4.5	526	718.6	28.2	50	se.	4.5
Kite flight.											
6.41 p. m...	717.3	21.4	70	nw.	8.9	526	717.3	21.4	70	nw.	8.9
6.59 p. m...	717.3	21.2	72	nw.	10.7	1,079	673.0	20.9	70	w.	8.7
7.16 p. m...	717.4	21.0	72	nw.	9.4	1,511	640.3	18.2	67	w.	6.5
7.36 p. m...	717.5	20.6	75	nw.	10.7	2,486	570.2	8.3	80	sw.	6.9
7.48 p. m...	717.5	20.5	75	nw.	10.3	1,369	650.7	17.3	80	wsw.	5.7
7.51 p. m...	717.6	20.4	75	nw.	9.8	904	686.9	18.6	72	w.	8.7
7.54 p. m...	717.6	20.4	76	nw.	9.4	526	717.6	20.4	76	nw.	9.4
May 24:											
12.56 p. m...	718.4	24.6	51	wnw.	5.4	526	718.4	24.6	51	wnw.	5.4
1.17 p. m...	718.2	25.5	48	wnw.	9.8	758	699.5	22.4	55	w.	7.2
1.26 p. m...	718.1	25.6	50	wnw.	8.0	1,521	640.0	14.4	74	w.	9.4
2.05 p. m...	717.8	26.4	48	w.	6.3	1,905	611.2	11.0	95	w.	9.4
2.14 p. m...	717.7	26.6	41	w.	6.7	2,394	576.2	6.6	100	w.	12.3
2.36 p. m...	717.6	26.5	40	wnw.	7.6	3,118	527.2	0.5	100	w.	15.0
2.57 p. m...	717.4	27.0	42	nw.	4.0	4,051	468.3	—9.1	40	w.	16.6
3.30 p. m...	717.2	27.6	42	nw.	6.7	3,124	526.4	—0.2	100	w.	12.6
3.40 p. m...	717.2	27.6	43	ese.	3.1	2,471	570.8	4.8	100	w.	7.6
3.54 p. m...	717.1	24.2	64	e.	3.1	1,540	638.0	14.9	81	wnw.	7.5
4.04 p. m...	717.1	24.7	60	ese.	2.7	1,097	671.7	20.4	61	wnw.	9.4
4.15 p. m...	717.1	25.1	59	ese.	2.7	526	717.1	25.1	59	ese.	2.7
May 25:											
7.02 a. m....	717.5	17.1	60	wnw.	12.3	526	717.5	17.1	60	wnw.	12.3
7.09 a. m....	717.5	17.2	60	wnw.	12.3	945	683.2	13.9	75	nnw.	10.0
7.18 a. m....	717.4	17.3	62	wnw.	12.7	1,443	643.7	10.9	73	nw.	15.3
7.27 a. m....	717.4	17.6	61	wnw.	13.0	1,921	607.7	6.9	72	nw.	16.8
7.37 a. m....	717.3	17.8	59	wnw.	13.0	2.080	596.0	7.8	44	nw.	11.4
7.52 a. m....	717.2	18.1	59	wnw.	13.0	2,436	571.0	7.1	21	nw.	12.0
8.26 a. m....	717.2	19.2	58	wnw.	13.0	3,711	487.9	— 2.4	......	nw.	16.0
8.55 a. m....	717.1	19.8	56	wnw.	13.6	5,071	410.0	—12.5	......	nnw.	19.6
9.44 a. m....	717.1	20.6	51	wnw.	13.6	4,435	445.7	— 5.4	......	nnw.	18.9
10.28 a. m....	717.1	21.5	50	wnw.	....	3,717	487.8	1.1	......	nnw.	16.2
10.47 a. m....	716.8	21.8	50	nw.	14.3	3,476	502.5	— 0.6	......	nnw.	14.0
11.10 a. m....	716.8	21.9	49	nnw.	17.0	2,877	541.4	3.9	......	nnw.	15.0
11.26 a. m....	716.8	22.9	47	nw.	15.0	2,239	585.4	8.5	......	nnw.	11.3
11.43 a. m....	716.7	23.4	44	wnw.	14.0	1,474	641.8	11.6	76	nw.	7.2
11.57 a. m....	716.7	23.4	44	wnw.	13.3	526	716.7	23.4	44	wnw.	13.3

May 23.—Balloon ascension: One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,400 m.

There were 7/10 to 4/10 Ci.-St. from the west-southwest and a few to 1/10 Cu. from the southwest.

Kite flight: Five kites were used; lifting surface, 32 sq. m. Wire out, 3,850 m.; at maximum altitude, 2,600 m.

There were 8/10 A.-Cu. from the west-southwest and a few Cu. from the southwest. Pressure was high over the Gulf of St. Lawrence and low over Wisconsin.

May 24.—Four kites were used; lifting surface, 30.6 sq. m. Wire out, 6,000 m., at maximum altitude.

There were 5/10 to 7/10 Cu., altitude 2,700 m., and 2/10 to 3/10 Cu.-Nb., all from the west.

Pressure was high over Kentucky and Tennessee and low north of the lower Lakes.

May 25.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 8,000 m.; at maximum altitude, 7,800 m.

There were a few to 1/10 A.-Cu. from the northwest at the beginning of the flight, and a few to 1/10 Cu. from the northwest after 8.55 a. m. There was light haze.

Pressure was high from Ontario southwestward to the Gulf States. Centers of low pressure were over the St. Lawrence Valley, southern New England, and southern Minnesota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 26:	mm.	° C.	%		m. p. s.	m.	mm.	° C.	%		m. p. s.
2.25 p. m....	715.6	22.4	51	se.	5.4	526	715.6	22.4	51	se.	5.4
3.02 p. m....	715.4	22.8	52	se.	6.7	1,128	667.3	17.3	60	ese.	6.5
3.32 p. m....	715.6	22.1	54	ese.	6.3	1,395	647.0	15.6	70	se.	4.9
4.30 p. m....	715.6	22.0	56	se.	4.9	1,080	671.2	17.3	71	se.	6.3
4.37 p. m....	715.5	21.8	57	se.	4.9	526	715.5	21.8	57	se.	4.9
May 27:											
11.15 a. m....	720.7	22.9	60	ne.	3.6	526	720.7	22.9	60	ne.	3.6
11.32 a. m....	720.7	22.2	60	ne.	3.1	1,950	608.6	8.9	39	ne.	3.8
11.42 a. m....	720.7	21.8	63	n.	3.2	1,463	645.5	10.0	98	ne.	4.7
11.56 a. m....	720.7	22.0	61	ne.	2.7	1,327	656.0	11.0	98	ne.	2.6
12.09 p. m...	720.7	22.4	60	nne.	3.2	865	693.0	16.1	72	ne.	1.6
12.14 p. m...	720.6	22.2	60	nne.	3.2	526	720.6	22.2	60	nne.	3.2
May 28:											
10.20 a. m....	721.3	24.0	53	ese.	2.7	526	721.3	24.0	53	ese.	2.7
10.58 a. m....	721.4	24.8	50	e.	3.6	1,643	633.2	12.8	90	e.	....
11.12 a. m....	721.4	25.0	50	ese.	3.6	975	685.1	17.9	82	ene.	....
11.17 a. m....	721.4	25.0	50	se.	3.6	526	721.4	25.0	50	se.	3.6
May 29:											
2.26 p. m...	719.0	27.6	40	se.	4.0	526	718.9	27.6	40	se.	4.0
2.45 p. m...	718.9	27.6	43	se.	4.5	2,031	603.3	11.1	61	ene.	2.8
2.53 p. m...	718.9	27.6	37	se.	4.2	1,740	624.7	13.8	63	e.	2.7
3.09 p. m...	718.9	27.7	42	se.	4.0	1,231	663.2	16.9	71	se.	2.9
3.30 p. m...	718.9	27.9	42	sse.	3.8	526	718.9	27.9	42	sse.	3.8

May 26.—Three kites were used; lifting surface, 24.3 sq. m. Wire out, 2,000 m.; at maximum altitude, 1,600 m.

There were 4/10 to 5/10 A.-Cu. and A.-St. from the northwest and after 3.36 p. m. a few to 3/10 St.-Cu. from the same direction.

Pressure was high over Tennessee and low over Colorado and off the middle Atlantic coast.

May 27.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,650 m.; There were 1/10 to 4/10 Cu. from the northeast. The altitude of their base was about 1,300 m.

Pressure was high east of the Mississippi River, with center over the New England coast, and low over Manitoba.

May 28.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,800 m. There were a few Cu. from the east-northeast.

Pressure was relatively high over Virginia and off the New Jersey coast. Pressure was relatively low over Quebec.

May 29.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 3,100 m. There were a few St.-Cu. from the southeast at the beginning of the flight and 1/10 to 2/10 A.-St. from the north-northwest from 3.14 p. m. to the end of the flight.

Centers of high pressure overlay upper Michigan and Louisiana, and pressure was relatively low over northern New England and the St. Lawrence Valley.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
May 30:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7.54 a. m....	720.0	20.0	73	nw.	4.0	526	720.0	20.0	73	nw.	4.0
8.07 a. m....	720.0	20.5	72	nnw.	3.1	2,289	585.6	10.7	77	nnw.	....
8.19 a. m....	720.0	20.7	73	nw.	3.1	1,522	641.2	15.2	70	nw.	....
8.46 a. m....	720.1	21.2	67	nw.	4.9	850	693.7	19.6	71	n.	....
8.53 a. m....	720.1	21.3	68	nnw.	4.5	526	720.1	21.3	68	nnw.	4.5
May 31:											
11.31 a. m....	715.3	22.4	78	se.	6.3	526	715.3	22.4	78	se.	6.3
11.45 a. m....	715.2	23.0	77	se.	6.7	906	684.5	18.0	91	s.	9.8
12.25 p. m...	714.7	24.2	64	se.	7.6	1,391	646.4	16.9	68	sw.	7.2
12.34 p. m...	714.6	24.3	65	se.	7.6	2,023	600.0	12.0	77	sw.	7.1
1.45 p. m...	713.8	24.5	68	s.	4.9	2,999	532.8	5.0	75	sw.	8.9
1.55 p. m...	713.7	24.7	68	s.	5.8	3,569	496.3	−1.2	88	sw.	11.8
2.07 p. m...	713.5	25.2	64	s.	6.3	3,322	511.5	1.0	88	sw.	9.8
2.17 p. m...	713.4	24.9	62	s.	8.0	2,861	541.4	4.7	82	ssw.	8.3
2.25 p. m...	713.4	24.6	62	s.	7.2	2,470	567.8	6.7	88	ssw.	10.5
2.41 p. m...	713.2	24.4	62	s.	4.9	526	713.2	24.4	62	s.	4.9
June 1:											
6.07 a. m....	711.6	16.5	77	wnw.	8.0	526	711.6	16.5	77	wnw.	8.0
6.12 a. m....	711.6	16.8	76	wnw.	8.0	1,025	671.0	13.7	83	wnw.	11.2
6.23 a. m....	711.6	16.7	75	wnw.	8.9	1,646	623.1	9.8	98	nw.	14.7
6.37 a. m....	711.7	16.5	78	wnw.	9.4	2,281	577.0	4.8	97	nw.	13.3
6.44 a. m....	711.7	16.5	80	wnw.	9.8	2,502	561.7	8.0	......	nw.	13.3
7.06 a. m....	711.7	16.0	87	wnw.	7.6	2,923	533.7	6.5	......	nw.	5.6
8.53 a. m....	711.9	16.7	78	wnw.	14.3	4,718	426.8	−6.8	......	wnw.	17.7
9.53 a. m....	712.2	17.2	72	wnw.	11.6	3,597	491.5	1.7	......	nw.	13.1
10.11 a. m....	712.2	17.3	71	wnw.	10.7	2,572	557.4	7.5	......	nw.	14.3
10.23 a. m....	712.3	17.4	69	wnw.	11.2	2,098	590.3	9.8	......	nw.	12.3
10.30 a. m....	712.3	17.6	70	nw.	9.8	1,684	620.4	9.8	......	nw.	12.5
10.36 a. m....	712.3	17.8	68	nw.	9.8	1,486	635.4	7.5	......	nw.	11.8
10.43 a. m....	712.4	17.8	68	nw.	9.4	1,007	673.0	11.5	......	nw.	8.3
10.48 a. m....	712.4	18.0	68	nw.	11.2	526	712.4	18.0	68	nw.	11.2

May 30.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,500 m. The sky was cloudless until 8.45 a. m., when Cu. began to form.

Pressure was high over the lake region and was relatively low off the New Jersey coast.

May 31.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 5,600 m.; at maximum altitude, 4,800 m.

There were 8/10 to 4/10 A.-Cu. from the southwest. After 11.55 a. m. there were 1/10 to 5/10 St.-Cu. and Cu. from the south. A thunderstorm with heavy rain reached the station at 2.42 p. m.

Pressure was high over Nova Scotia and low over Michigan.

June 1.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,200 m.

There were 3/10 to 8/10 St.-Cu. and Cu. from the northwest; altitude of St.-Cu., 1,400 m.

Pressure was high over the middle Mississippi Valley and low just north of New England.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
June 2:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.37 a. m.	717.6	15.0	71	wnw.	5.4	526	717.6	15.0	71	wnw.	5.4
6.44 a. m.	717.7	15.2	71	wnw.	6.7	905	686.5	15.3	71	nnw.	7.4
7.00 a. m.	717.8	15.5	71	wnw.	7.2	1,127	668.8	16.2	......	nnw.	6.0
7.08 a. m.	717.9	15.8	71	wnw.	5.8	1,317	654.2	14.8	......	nnw.	4.7
7.50 a. m.	718.2	18.3	61	wnw.	3.6	1,694	625.9	12.0	......	nnw.	4.7
7.55 a. m.	718.2	18.4	62	wnw.	3.6	1,605	632.4	12.8	......	nnw.	4.2
8.00 a. m.	718.3	18.7	62	wnw.	3.6	1.247	660.0	13.9	......	nnw.	4.0
8.06 a. m.	718.3	19.0	61	wnw.	3.6	839	692.5	15.3	......	nnw.	4.0
8.15 a. m.	718.3	18.8	64	wnw.	4.5	526	718.3	18.8	64	wnw.	4.5
June 3:											
9.00 a. m.	719.3	20.2	77	wnw.	2.2	526	719.3	20.2	77	wnw.	2.2
9.11 a. m.	719.3	20.2	76	wnw.	2.2	1,880	614.2	12.5	......	w.	....
9.27 a. m.	719.3	20.8	75	wnw.	2.2	1.034	678.3	19.8	......	w.	....
9.52 a. m.	719.3	21.7	66	w.	2.7	773	699.1	19.3	......	w.	....
10.01 a. m.	719.3	21.6	70	wnw.	2.7	526	719.3	21.6	70	wnw.	2.7
June 4:											
5.19 p. m.	718.7	22.0	70	se.	7.6	526	718.7	22.0	70	se.	7.6
5.25 p. m.	718.7	22.0	70	se.	7.6	876	690.3	19.0	73	sse.	7.6
5.40 p. m.	718.7	21.7	71	se.	7.2	1,262	659.8	16.1	78	sse.	7.4
6.35 p. m.	718.6	21.0	75	se.	5.8	1,763	622.0	13.1	81	ssw.	4.0
6.47 p. m.	718.5	20.6	78	se.	6.7	1,334	654.0	16.4	80	s.	7.4
6.55 p. m.	718.5	20.3	80	se.	7.2	948	684.3	17.9	81	sse.	8.7
7.02 p. m.	718.5	20.0	82	se.	6.7	526	718.5	20.0	82	se.	6.7
June 5:											
3.31 p. m.	713.7	24.1	81	s.	2.2	526	713.7	24.1	81	s.	2.2
3.43 p. m.	713.7	25.6	75	se.	2.2	1,726	621.4	16.5	......	wnw.	....
4.07 p. m.	713.6	26.0	72	ese.	2.7	1,371	647.6	17.9	......	w.	....
4.24 p. m.	713.4	24.4	76	ese.	3.6	987	676.7	20.6	......	ssw.	....
4.33 p. m.	713.4	24.8	76	ese.	3.1	526	713.4	24.8	76	ese.	3.1
June 6:											
3.52 p. m.	716.0	14.3	95	ene.	2.7	526	716.0	14.3	95	ene.	2.7
4.03 p. m.	716.0	14.0	96	ese.	2.7	1,973	603.8	14.7	......	wnw.	....
4.14 p. m.	716.1	13.8	97	e.	2.7	1,348	649.9	17.2	......	wnw.	....
4.28 p. m.	716.1	13.6	98	wnw.	3.1	790	694.1	12.5	......	wnw.	....
4.32 p. m.	716.2	14.0	98	n.	3.1	526	716.2	14.0	98	n.	3.1

June 2.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 2,400 m.; at maximum altitude, 1,900 m.

There were 3/10 to 4/10 A.-Cu. from the west. About 4/10 Ci.-St. from the west disappeared after 7.10 a. m. A solar halo was observed.

Pressure was low over the Gulf of St. Lawrence and high over West Virginia.

June 3.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,800 m.

There were about 8/10 Ci.-St. and Ci.-Cu. from the west. A solar halo was observed.

Pressure was generally high over the eastern part of the country.

June 4.—Five kites were used; lifting surface, 36.4 sq. m. Wire out, 3,500 m.; at maximum altitude, 2,100 m.

There were 7/10 to 6/10 St.-Cu. from the northwest and 2/10 Ci.-Cu. from the same direction after 5.53 p. m. Light rain fell at intervals from 5.27 to 6.57 p. m.

Pressure was high over New York and Ontario and low over Iowa.

June 5.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m.

There were 7/10 Ci.-St. from the northwest and few Cu. from the west.

Pressure was low over Ontario and high off New England and along the Gulf coast.

June 6.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

Dense fog and light rain prevailed.

Pressure was high over Nova Scotia and comparatively low over Virginia, the upper Lakes, and Oklahoma.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
June 7:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
2.35 p. m...	718.4	14.8	99	e.	4.9	526	718.4	14.8	99	e.	4.9
4.36 p. m...	718.4	15.6	96	e.	3.6	938	....	14.5	92	ese.	5.7
4.50 p. m...	718.4	16.0	94	e.	3.1	526	718.4	16.0	94	e.	3.1
June 8:											
2.47 p. m...	719.7	17.2	84	e.	3.6	526	719.7	17.2	84	e.	3.6
3.04 p. m...	719.7	16.6	83	e.	3.6	2,497	569.1	9.4	......	calm.	....
3.08 p. m...	719.7	16.5	84	e.	3.6	2,100	596.8	11.3	......	calm.	....
3.12 p. m...	719.7	16.5	84	e.	3.6	1,635	630.9	9.4	......	e.	....
3.31 p. m...	719.7	16.5	84	ese.	2.7	929	686.4	13.6	......	e.	....
3.35 p. m...	719.7	16.5	84	se.	2.7	526	719.7	16.5	84	se.	2.7
June 9:											
3.42 p. m....	717.5	24.5	56	wnw.	1.3	526	717.5	24.5	56	wnw.	1.3
3.53 p. m....	717.4	25.2	51	wnw.	1.8	1,844	615.9	13.6	......	nnw.	....
4.07 p. m....	717.4	24.9	51	w.	2.2	2,726	553.5	8.0	......	nw.	....
4.22 p. m....	717.3	25.2	52	w.	1.8	2,031	601.6	11.9	......	nw.	....
4.39 p. m....	717.2	24.4	53	nw.	2.7	1,685	626.8	12.9	......	nnw.	....
4.50 p. m....	717.1	24.2	55	nw.	2.7	1,437	645.3	15.2	......	nw.	....
4.59 p. m....	717.1	24.2	53	nw.	2.2	914	686.0	19.8	......	nw.	....
5.04 p. m....	717.1	24.0	56	nw.	2.2	526	717.1	24.0	56	nw.	2.2
June 10:											
7.53 a. m....	715.9	20.7	68	w.	7.2	526	715.9	20.7	68	w.	7.2
8.30 a. m....	715.8	21.0	72	w.	5.8	761	696.9	22.5	44	wnw.	7.2
9.57 a. m....	715.5	23.3	62	w.	5.4	1,178	664.2	21.3	31	nw.	8.3
10.32 a. m....	715.4	24.9	58	wsw.	3.1	1,631	630.0	17.1	68	nnw.	9.5
10.36 a. m....	715.4	25.0	58	wsw.	3.1	1,400	647.0	19.0	64	nnw.	9.5
10.48 a. m....	715.4	25.0	56	wsw.	2.7	984	678.9	20.2	41	nw.	5.6
10.52 a. m....	715.4	25.4	57	w.	2.7	526	715.4	25.4	57	w.	2.7

June 7.—One kite was used; lifting surface, 11.2 sq. m. Wire out, 900 m.; at maximum altitude, 800 m.

10/10 St. from the east and east-southeast were visible except from 3.07 to 3.50 p. m., when dense fog prevailed.

Pressure was high over Quebec and low over the South Atlantic States.

June 8.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

The sky was covered with St. clouds, with no apparent direction; altitude, 1,600 m.

Pressure was high over the lower Lakes, New England, and Nova Scotia and low over the east Gulf States.

June 9.—Two captive balloons were used; capacity, 36.5 cu .m. Wire out, 3,000 m.

There were 2/10 Ci. from the west and a few Cu. from the northwest, altitude 2,700 m.

High pressure extended from New York to Georgia. Low pressure was central over South Dakota.

June 10.—Three kites were used; lifting surface, 21.4 sq. m. Wire out, 1,700 m.; at maximum altitude, 1,500 m.

A.-Cu., from the northwest, diminished from 7/10 to few.

Pressure was high over the southeastern States and low over Wisconsin, Iowa, and Missouri.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
June 11:	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
6.59 a. m....	713.3	24.6	66	w.	9.8	526	713.3	24.6	66	w.	9.8
7.10 a. m....	713.3	24.7	64	w.	10.1	1,019	674.4	24.2	65	nw.	14.6
7.30 a. m....	713.4	25.1	64	wnw.	9.8	1,493	638.9	21.0	51	nw.	13.0
7.53 a. m....	713.5	25.5	63	w.	10.3	1,994	602.9	16.3	58	nw.	12.5
8.18 a. m....	713.5	26.2	62	w.	9.8	2,768	550.4	9.1	56	nw.	13.3
9.08 a. m....	713.5	26.5	65	wnw.	10.3	3,326	514.4	4.1	68	nw.	8.3
9.53 a. m....	713.3	28.2	63	wnw.	14.3	4,165	463.6	−3.4	73	wnw.	15.3
10.30 a. m....	713.4	29.2	53	wnw.	8.0	3,552	501.0	4.1	49	wnw.	12.9
10.48 a. m....	713.2	29.5	52	wnw.	6.3	2,903	541.8	8.9	56	wnw.	14.0
11.08 a. m....	713.2	30.1	51	w.	8.0	2,245	585.9	15.9	49	wnw.	13.5
11.28 a. m....	713.0	30.4	49	w.	7.2	1,485	639.8	21.0	81	wnw.	11.7
11.42 a. m....	712.9	31.0	46	wnw.	6.0	855	687.3	28.4	46	wnw.	6.4
11.52 a. m....	712.8	31.0	44	wnw.	6.5	526	712.8	31.0	44	wnw.	6.5
June 12:											
7.54 a. m....	711.8	18.0	94	ese.	8.0	526	711.8	18.0	94	ese.	8.0
8.01 a. m....	711.8	17.8	96	ese.	8.0	899	681.5	17.1	71	ese.	13.3
8.24 a. m....	711.7	18.3	95	ese.	9.8	1,412	641.6	15.1	72	se.	6.1
9.55 a. m....	711.4	19.6	91	ese.	10.3	1,880	607.0	13.4	56	s.	11.2
10.12 a. m....	711.4	19.7	92	se.	9.8	2.162	587.1	11.4	46	ssw.	18.0
10.27 a. m....	711.3	20.0	90	se.	9.8	2,864	539.2	5.6	98	sw.	18.7
10.37 a. m....	711.3	20.1	90	ese.	10.7	3,265	513.4	2.6	99	sw.	22.0
10.42 a. m....	711.3	20.1	90	e.	8.9	3,370	506.7	1.3	65	sw.	26.6
10.46 a. m....	711.2	20.0	90	e.	9.8	526	711.2	20.0	90	e.	9.8
June 13:											
4.51 p. m....	708.7	17.4	81	wnw.	10.3	526	708.7	17.4	81	wnw.	10.3
4.58 p. m....	708.7	18.4	78	wnw.	10.7	984	671.7	15.4	73	nw.	12.7
5.12 p. m....	708.7	17.8	82	wnw.	8.5	1,536	629.3	12.1	66	wnw.	12.7
5.25 p. m....	708.8	18.0	82	wnw.	9.4	2,131	586.2	8.3	66	wnw.	9.8
6.02 p. m....	708.9	18.9	76	wnw.	8.9	2,308	573.8	5.1	81	wnw.	8.0
6.23 p. m....	708.9	18.5	74	wnw.	8.9	3,190	514.4	−1.3	100	w.	8.3
6.36 p. m....	708.9	18.1	72	nw.	10.3	2,769	541.9	2.0	90	w.	8.0
6.46 p. m....	708.9	17.8	77	nw.	9.8	2,104	588.0	7.8	79	wnw.	7.4
6.58 p. m....	708.9	17.8	75	wnw.	8.5	1,424	637.8	13.1	66	wnw.	9.6
7.09 p. m....	708.9	17.8	75	wnw.	8.5	887	679.6	14.9	70	nw.	8.7
7.15 p. m....	708.9	17.6	75	wnw.	8.5	526	708.9	17.6	75	wnw.	8.5

June 11.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 9,000 m.; at maximum altitude, 7,600 m.

There were 6/10 Ci.-St. from the west at 7.20 a. m., a few Ci. from the west at 8.45 a. m., and a few Cu. from the west-northwest towards the end of the flight. Light haze.

Pressure was low over the upper Lake region, with a secondary center off the southern New England coast, and relatively high over New Brunswick.

June 12.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 5,000 m.; at maximum altitude.

At the beginning of the flight there were 5/10 Ci.-St. from the west and 5/10 St., altitude 700 m., from the east-southeast. The St. increased to 10/10 by 8 a. m. and changed to south about 10 a. m. Light rain fell from 10.45 to 11 a. m.

Pressure was low over the upper lakes and high over Nova Scotia.

June 13.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 6,000 m.; at maximum altitude, 4,400 m.

There were a few to 3/10 A.-Cu., 2/10 to 7/10 St.-Cu., altitude, 3,200 m., and a few low St., all from the west.

Pressure was low over Ontario and over Virginia and high over South Dakota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911. June 14:	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
6.36 a. m....	710.3	14.5	90	wnw.	7.2	526	710.3	14.5	90	wnw.	7.2
6.46 a. m....	710.3	14.7	88	wnw.	8.0	892	680.1	11.7	94	nw.	11.2
7.00 a. m....	710.3	15.0	87	wnw.	7.2	1,508	631.6	7.2	100	nw.	13.3
7.20 a. m....	710.3	15.3	86	wnw.	7.6	2,312	572.4	2.2	91	nw.	12.3
7.35 a. m....	710.3	15.5	85	wnw.	7.2	2,658	548.4	− 0.7	100	nw.	9.6
8.09 a. m....	710.3	15.5	85	wnw.	8.0	2,772	540.6	3.0	51	nw.	7.4
8.29 a. m....	710.3	15.4	86	wnw.	7.2	2,783	539.7	− 1.1	95	nw.	9.5
8.34 a. m....	710.4	15.4	85	wnw.	7.6	2,981	526.7	0.3	......	wnw.	13.3
8.43 a. m....	710.4	15.5	85	wnw.	7.2	3,499	493.8	− 1.4	12	wnw.	17.9
9.13 a. m....	710.4	16.0	84	wnw.	8.9	3,007	525.0	2.3	6	wnw.	12.9
9.17 a. m....	710.4	16.1	83	wnw.	8.0	2,828	537.0	− 2.1	81	wnw.	7.4
9.32 a. m....	710.5	16.3	80	wnw.	8.5	2,623	551.0	4.2	32	nw.	18.7
9.40 a. m....	710.5	16.4	79	wnw.	7.6	2,456	562.5	0.2	99	nw.	15.3
10.01 a. m....	710.5	15.7	81	wnw.	7.6	1,585	625.9	6.7	94	nw.	13.3
10.14 a. m....	710.5	16.3	82	wnw.	7.6	959	675.1	11.8	87	nw.	11.2
10.22 a. m....	710.5	16.1	81	wnw.	7.6	526	710.5	16.1	81	wnw.	7.6
June 15:											
6.45 a. m....	712.3	14.5	69	wnw.	7.6	526	712.3	14.5	69	wnw.	7.6
6.53 a. m....	712.3	14.2	70	wnw.	7.2	967	676.0	11.8	60	nw.	13.0
7.11 a. m....	712.3	14.3	70	wnw.	8.0	1,484	635.2	7.2	57	nnw.	13.2
7.22 a. m....	712.3	14.9	67	wnw.	7.2	1,881	605.4	4.1	57	nnw.	14.5
7.39 a. m....	712.4	15.5	67	wnw.	8.0	2,527	558.7	− 1.8	56	nw.	14.5
7.42 a. m....	712.4	15.6	67	wnw.	8.0	2,685	548.0	− 0.9	......	nw.	15.3
8.09 a. m....	712.4	16.3	67	wnw.	6.7	3,316	505.9	− 5.3	......	nw.	....
8.44 a. m....	712.3	17.4	67	wnw.	7.2	3,597	488.2	− 7.3	......	nw.	....
9.48 a. m....	712.2	18.3	57	wnw.	8.9	3,957	466.3	− 8.7	......	nw.	....
10.10 a. m....	712.2	18.4	57	wnw.	8.5	4,354	443.1	−11.5	......	nw.	....
10.50 a. m....	712.1	18.5	54	wnw.	8.9	5,168	398.0	−16.9	......	nw.	....
11.46 a. m....	712.0	14.8	75	nnw.	10.7	4,108	456.5	−10.8	......	nw.	....
12.07 p. m....	712.0	16.2	67	nnw.	9.4	3,535	491.7	− 7.7	100	nw.	16.8
12.41 p. m....	711.8	17.1	64	wnw.	6.7	3,069	521.9	− 2.9	79	nw.	15.7
12.44 p.m....	711.8	17.1	64	wnw.	6.7	2,979	527.9	− 4.2	100	nw.	15.7
1.02 p. m....	711.7	18.0	67	wnw.	8.5	2,556	556.8	− 1.5	95	nw.	15.0
1.26 p. m....	711.6	18.4	56	wnw.	9.8	2,041	593.5	3.1	80	nw.	12.9
1.41 p. m....	711.6	19.4	52	wnw.	9.4	1,561	629.5	8.1	66	wnw.	14.0
1.54 p. m....	711.5	19.8	53	wnw.	9.8	1,039	670.0	13.0	65	wnw.	9.0
1.58 p. m....	711.5	20.1	52	wnw.	9.8	526	711.5	20.1	52	wnw.	9.8

June 14.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7,000 m.; at maximum altitude, 6,500 m.

8/10 to 10/10 St.-Cu., from the northwest, increased in altitude from 1,700 m. to 2,600 m. After 9.45 a. m. they were gradually obscured by a lower layer of St.-Cu., also; from the northwest, at an altitude of 1,300 m. Between 7.30 and 8 a. m. there were some very low St. from the west-northwest.

Low pressure, central over New England, covered the eastern part of the country.

June 15.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,400 m.

Ci.-St., from the west-northwest, decreased from 5/10 at the beginning to none by 8.30 a. m. There was a solar halo. St.-Cu., from the northwest, appeared about 9 a. m. and covered 7/10 to 10/10 of the sky from 10.30 a. m. to 1 p. m., decreasing thereafter to 4/10. Their altitude diminished from 2,800 to 2,400 m. Light rain fell form 11.20 to 11.50 a. m. After 1.30 p. m. there were about 2/10 Ci.-St. from the west-northwest.

Pressure was low over Maine and New Brunswick and relatively high from the upper Lakes southward to the Gulf of Mexico.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
June 16:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.43 a. m....	713.2	15.4	68	w.	6.3	526	713.2	15.4	68	w.	6.3
6.50 a. m....	713.2	15.5	69	w.	6.7	910	681.7	13.6	68	wnw.	12.0
7.00 a. m....	713.2	15.6	68	w.	7.6	1,123	664.5	12.5	68	wnw.	9.0
7.30 a. m....	713.2	16.2	67	w.	8.5	2,549	558.8	− 0.1	77	wnw.	20.7
7.50 a. m....	713.2	16.4	67	w.	8.5	3,521	494.6	− 3.5	23	wnw.	20.7
8.07 a. m....	713.2	16.6	69	w.	8.0	4,105	459.0	− 8.6	10	wnw.	27.9
8.25 a. m....	713.1	16.6	69	w.	8.9	4,576	432.0	−12.7	......	wnw.	31.5
9.02 a. m....	712.9	17.0	69	w.	8.9	4,922	412.8	−15.7	44	wnw.	27.8
10.03 a. m....	712.6	18.9	63	w.	9.4	4,407	441.7	−12.3	......	wnw.	26.8
10.15 a. m....	712.5	19.5	60	w.	8.9	4,223	452.4	− 9.9	......	wnw.	26.8
11.35 a. m....	712.1	21.2	56	w.	11.6	1,985	599.0	5.4	48	wnw.	19.8
11.50 a. m....	712.0	21.5	52	w.	9.8	1,415	641.6	11.7	63	wnw.	15.5
12.00 m......	712.0	21.4	54	w.	12.5	953	677.6	16.6	56	wnw.	15.0
12.08 p. m....	711.9	21.0	54	w.	11.2	526	711.9	21.0	54	w.	11.2
June 17:											
9.57 a. m....	715.4	17.8	68	se.	5.4	526	715.4	17.8	68	se.	5.4
10.08 a. m....	715.4	17.7	70	se.	5.8	710	700.2	15.0	73	sse.	6.2
11.34 a. m....	715.2	18.5	68	se.	6.3	1,016	675.3	16.8	68	ssw.	7.1
12.37 p. m....	715.1	16.9	76	s.	6.3	1,299	653.1	13.6	67	ssw.	6.4
12.59 p. m....	715.1	16.6	74	s.	5.4	2,016	599.4	7.6	89	sw.	10.1
1.15 p. m....	715.1	16.8	73	s.	5.8	2,303	578.9	6.6	93	w.	6.1
1.27 p. m....	715.1	16.6	75	s.	6.3	3,280	513.7	3.2	100	wnw.	19.8
1.55 p. m....	715.0	15.6	85	s.	5.4	526	715.0	15.6	85	s.	5.4
June 18:											
4.18 p. m...	714.6	18.8	85	n.	1.8	526	714.6	18.8	85	n.	1.8
4.39 p. m...	714.5	18.9	87	e.	1.8	1,458	640.5	12.7	......	nnw.	....
4.46 p. m...	714.5	18.9	84	ese.	1.8	1,103	667.8	14.9	......	n.	....
4.57 p. m...	714.5	18.9	88	se.	1.8	817	690.7	16.4	......	nne.	....
5.04 p. m...	714.5	18.8	90	sse.	1.8	526	714.5	18.8	90	sse.	1.8
June 19:											
2.42 p. m...	715.9	21.6	64	se.	4.0	526	715.9	21.6	64	se.	4.0
3.08 p. m...	715.8	22.5	58	se.	5.8	2,255	584.0	9.8	......	w.	....
3.20 p. m...	715.7	23.2	56	se.	4.9	1,659	627.0	13.6	......	sw.	....
3.35 p. m...	715.6	22.1	61	se.	4.0	842	690.0	17.7	......	se.	....
3.41 p. m...	715.6	21.4	61	se.	3.6	526	715.6	21.4	61	se.	3.6

June 16.--Five kites were used; lifting surface, 31.5 sq. m. Wire out, 9,500 m.; at maximum altitude, 8,800 m.

There were 7/10 to 10/10 A.-Cu. and A.-St. from the west-northwest and a few St. from the west. A solar halo was observed.

Pressure was high from Ohio southward and low over Nebraska and over Maine.

June 17.—Five kites were used; lifting surface, 37.4 sq. m. Wire out, 4,300 m., at maximum altitude.

There were 7/10 A.-Cu. from the west-northwest at 10 a. m.; 10/10 A.-St. from the west at 12 m.; and 10/10 St.-Cu. from the west after 12.45 p. m. The St.-Cu. decreased in altitude from 2,200 m. to 1,800 m. Light rain fell from 12.47 to 1.05 p. m. and heavy rain after 1.45 p. m.

Lows were central over Missouri and the lower St. Lawrence Valley. There was no well defined high.

June 18.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 2/10 to 3/10 Ci.-St. from the west-southwest and 4/10 to 5/10 St. from the north; altitude of St., 1,000 m.

There was no well defined high or low over the eastern part of the country.

June 19.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,050 m.

There were 8/10 A.-Cu. and a few to 1/10 Ci., all from the west.

Pressure was high over Iowa and low over the Gulf of St. Lawrence and Louisiana.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
June 20:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.50 a. m....	714.9	18.3	85	wnw.	6.3	526	714.9	18.3	85	wnw.	6.3
7.05 a. m....	714.9	18.5	83	wnw.	6.3	707	700.2	20.2	......	nuw.	....
7.12 a. m....	714.9	18.7	84	wnw.	6.3	1,210	660.4	16.8	......	nnw.	....
7.37 a. m....	715.0	19.2	80	wnw.	6.3	1,914	007.9	11.6	......	n.	....
7.47 a. m....	715.0	19.5	76	wnw.	6.7	2,454	570.0	9.2	......	n.	....
8.09 a. m....	715.0	19.5	75	wnw.	7.2	3,086	527.9	6.0	......	nnw.	....
8.40 a. m....	715.0	19.8	74	wnw.	7.6	3,893	478.2	0.2	......	nnw.	....
9.00 a. m....	715,0	20.4	76	wnw.	7.6	4,563	440.0	− 2.4	......	nw.	....
9.49 a. m....	715.0	21.6	73	wnw.	6.7	5,346	398.0	− 9.0	......	nw.	....
11.25 a. m....	714.6	24.9	50	wnw.	8.9	4,588	438.1	− 3.0	......	nw.	....
12.30 p. m...	714.2	26.0	48	wnw.	11.6	3,662	491.6	3.4	......	nw.	....
12.33 p. m...	714.1	26.0	48	wnw.	11.6	3,503	501.2	2.2	......	nw.	....
12.39 p. m...	714.1	26.2	48	wnw.	11.2	3,354	510.6	4.2	......	nw.	....
12.42 p. m...	714.0	26.2	48	wnw.	11.2	3,110	525.9	3.4	......	nw.	....
12.58 p. m...	713.9	26.5	46	wnw.	11.2	2,371	575.6	8.9	......	nw.	....
1.12 p. m...	713.9	26.6	45	wnw.	9.8	1,865	611.5	12.9	......	nw.	....
1.31 p. m...	713.8	26.8	46	wnw.	8.9	1,442	642.7	17.4	......	nw.	....
1.41 p. m...	713.8	26.3	46	wnw.	9.8	933	681.5	21.8	......	wnw.	....
1.50 p. m...	713.7	25.4	51	wnw.	9.8	526	713.7	25.4	51	wnw.	9.8
June 21:											
12.54 p. m...	718.1	22.2	37	wnw.	7.6	526	718.1	22.2	37	wnw.	7.6
1.00 p. m...	718.1	22.4	38	nw.	7.6	869	690.3	18.4	......	nw.	....
1.12 p. m...	718.1	22.9	40	wnw.	7.2	1,107	671.3	16.4	......	wnw.	....
1.33 p. m...	718.0	23.3	39	wnw.	6.3	1,535	638.3	13.3	......	nnw.	....
1.40 p. m...	718.0	23.2	38	wnw.	8.5	1,831	616.4	14.4	......	nnw.	....
2.04 p. m...	718.0	23.7	40	nw.	7.6	3,566	500.4	4.6	......	nnw.	....
2.31 p. m...	717.9	24.2	38	wnw.	6.7	4,343	454.6	0.0	......	nnw.	....
2.56 p. m...	717.8	25.0	37	wnw.	6.7	5,046	416.3	− 3.3	......	nnw.	....
3.32 p. m...	717.7	24.9	34	nw.	8.0	5,415	397.8	− 6.9	......	nnw.	....
4.27 p. m...	717.6	25.2	32	nw.	5.8	4,625	439.2	− 1.6	......	nnw.	....
4.55 p. m...	717.7	24.8	34	nw.	6.7	3,174	525.2	8.0	......	nnw.	....
5.04 p. m...	717.7	24.5	34	nw.	7.2	2,185	591.4	12.2	......	nnw.	....
5.13 p. m...	717.7	24.7	34	nw.	6.7	1,837	616.4	11.3	......	nw.	....
5.19 p. m...	717.7	24.6	35	nw.	6.7	1,364	651.7	17.0	......	nw.	....
5.29 p. m...	717.7	24.5	36	nw.	6.7	916	686.5	21.0	......	nw.	....
5.33 p. m...	717.7	24.4	36	nw.	6.7	526	717.7	24.4	36	nw.	6.7

June 20.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,700 m.

Few A.-St., from the northwest, were visible near the southern horizon until 10 a. m. Cu., also from the northwest, appeared about 11.30 a. m. and increased to 7/10 by the end of the flight.

Pressure was high from Lake Superior to Kansas and low over the Gulf of St. Lawrence.

June 21.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,200 m.

There were from a few to 2/10 Ci. from the northwest.

Pressure was high over the lake region and low off Nova Scotia.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
				Wind.						Wind.	
	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.
1911.											
June 22:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.18 a. m....	719.0	18.5	52	wnw.	6.3	526	719.0	18.5	52	wnw.	6.3
6.26 a. m....	719.0	18.6	52	wnw.	6.7	861	691.6	19.8	......	nw.	....
6.42 a. m...	719.1	19.0	54	wnw.	5.4	1,332	655.2	21.7	......	nnw.	....
6.52 a. m....	719.1	19.3	52	wnw.	5.4	1,717	626.8	18.4	......	nw.	....
7.26 a. m....	719.1	19.8	52	wnw.	4.5	2,516	570.6	10.7	......	nw.	....
7.50 a. m....	719.1	21.0	51	wnw.	4.5	3,275	520.8	4.6	......	nw.	....
8.13 a. m....	719.1	21.4	50	wnw.	5.4	3,855	484.7	1.5	......	nw.	....
8.28 a. m....	719.1	21.6	53	wnw.	5.4	4,380	454.1	−3.2	......	nw.	....
8.46 a. m....	719.1	21.6	52	wnw.	5.8	4,753	433.1	−2.2	......	nw.	....
10.20 a. m....	719.0	23.4	44	wnw.	7.2	5,639	387.4	−6.2	......	nw.	....
11.54 a. m....	718.3	25.3	37	wnw.	4.9	4,888	425.4	−1.8	......	nw.	....
12.22 p. m...	718.2	26.3	35	wnw.	4.5	4,475	448.3	−2.7	......	nw.	....
12.32 p. m...	718.1	26.5	35	wnw.	5.4	3,721	492.3	1.6	......	nw.	....
12.46 p. m...	718.1	26.6	34	wnw.	3.6	3,413	511.4	2.7	......	nw.	....
12.58 p. m...	718.0	26.8	37	wnw.	4.0	2,791	551.6	7.9	......	nw.	....
1.02 p. m...	718.0	26.9	36	wnw.	4.0	2,293	585.6	12.5	......	nw.	....
1.12 p. m...	717.9	27.2	36	wnw.	4.5	1,688	628.6	17.9	......	nw.	....
1.23 p. m...	717.8	27.6	39	wnw.	4.0	526	717.8	27.6	39	wnw.	4.0
June 23:											
9.08 a. m...	715.4	25.4	50	wnw.	13.4	526	715.4	25.4	50	wnw.	13.4
9.17 a. m....	715.4	25.4	50	wnw.	11.6	958	681.0	22.1	......	wnw.	....
9.30 a. m....	715.4	25.5	51	wnw.	11.6	1,444	644.1	20.6	......	nw.	....
9.39 a. m....	715.4	26.0	52	wnw.	11.2	1,873	612.9	16.7	......	nw.	....
10.12 a. m....	715.4	27.1	52	wnw.	8.0	3,534	502.6	5.2	......	nw.	....
10.50 a. m....	715.4	27.6	53	wnw.	10.3	4,347	454.7	−0.9	......	nw.	....
11.20 a. m....	715.4	28.0	50	wnw.	9.8	4,722	433.8	−4.2	......	nw.	....
11.48 a. m....	715.3	28.4	51	wnw.	8.9	5,221	407.1	−5.9	......	nw.	.....
11.51 a. m....	715.3	28.4	51	wnw.	9.8	5,446	395.6	−5.3	......	nw.	....
11.56 a. m....	715.3	28.5	50	wnw.	8.9	5,559	389.9	−5.7	......	nw.	....
12.15 p. m...	715.3	28.8	47	wnw.	8.0	5,172	408.9	−4.4	......	nw.	....
12.20 p. m...	715.3	28.8	47	wnw.	6.7	5,100	412.7	−6.4	......	nw.	....
12.56 p. m...	715.3	29.2	50	nw.	5.8	4,365	452.9	−0.8	......	nw.	....
1.19 p. m...	715.3	29.5	47	wnw.	6.3	3,157	525.5	6.3	......	nw.	....
1.36 p. m...	715.3	30.0	46	nw.	5.8	2,579	563.7	9.6	......	nw.	....
1.51 p. m...	715.3	30.0	44	nw.	6.3	1,574	634.8	18.4	......	nw.	....
2.00 p. m...	715.3	29.8	45	nw.	5.4	818	692.3	25.7	......	nw.	....
2.11 p. m...	715.3	29.2	45	nw.	4.5	526	715.3	29.2	45	nw.	4.5
June 24:											
6.16 a. m....	717.9	23.3	60	wnw.	8.0	526	717.9	23.3	60	wnw.	8.0
6.32 a. m....	718.0	22.8	64	nw.	2.7	1,134	669.8	23.3	......	nw.	....
6.47 a. m....	718.1	22.6	67	wnw.	6.7	1,443	646.7	21.9	......	nw.	....
7.18 a. m....	718.3	22.7	70	nw.	4.1	1,940	610.8	18.1	......	nw.	....
7.47 a. m....	718.5	23.2	67	nw.	1.4	2,350	582.1	13.1	......	nw.	....
7.59 a. m....	718.6	23.3	73	se.	2.3	2,087	599.9	16.0	......	nw.	....
8.12 a. m....	718.7	23.3	80	ese.	3.1	1,630	632.9	18.6	......	nw.	....
8.19 a. m....	718.7	23.0	81	ese.	2.7	901	688.5	21.4	......	nw.	....
8.22 a. m....	718.8	23.0	79	ese.	2.7	526	718.8	23.0	79	ese.	2.7

June 22.—Ten kites were used; lifting surface, 65 sq. m. Wire out, 12,500 m.; at maximum altitude, 11,900 m.

There were a few Ci.-Cu. from the northwest.

Pressure was high over the Middle and Southern Atlantic States and low over the Gulf of St. Lawrence.

June 23.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 11,500 m.; at maximum altitude, 10,400 m.

There were 6/10 to a few Ci. and Ci.-St. from the west and a few to 4/10 Cu. from the same direction after 1.17 p. m.

Pressure was low over Nova Scotia and high over Florida and the upper Lakes.

June 24.—Five kites were used; lifting surface, 33.5 sq. m. Wire out, 3,700 m.; at maximum altitude, 3,000 m.

There were 2/10 Ci.-St. and 1/10 A.-St. from the northwest. Light haze.

Pressure was relatively low over southeastern Virignia and high over Ontario and western New England and over Georgia.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
June 25:	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
1.40 p. m. . .	718.1	21.8	94	se.	6.0	526	718.1	21.8	94	se.	6.0
2.00 p. m. . .	718.0	21.5	92	se.	7.8	987	680.8	19.2	81	sse.	8.5
2.30 p. m. . .	718.0	21.7	94	se.	7.2	1,380	650.5	18.4	67	ssw.	9.1
2.38 p. m. . .	718.0	21.7	93	se.	6.3	2,343	580.8	10.6	89	ssw.	14.4
2.54 p. m. . .	718.0	21.6	94	se.	5.4	2,707	555.8	8.5	90	sw.	9.0
3.02 p. m. . .	718.0	21.6	94	sse.	4.7	3,087	530.4	5.1	98	sw.	14.0
3.18 p. m. . .	717.9	21.5	94	se.	4.2	2,329	580.8	9.9	94	ssw.	. . . . . .
3.29 p. m. . .	717.9	21.6	95	se.	4.5	1,780	620.1	12.1	89	ssw.	13.2
3.41 p. m. . .	717.8	21.6	97	se.	4.7	1,282	657.5	16.0	85	s.	12.7
3.48 p. m. . .	717.8	21.8	95	se.	4.9	793	696.1	19.3	87	sse.	9.0
3.52 p. m. . .	717.7	21.8	95	se.	4.9	526	717.7	21.8	95	se.	4.9
June 26:											
2.17 p. m. . . .	716.0	25.4	89	e.	1.8	526	716.0	25.4	89	e.	1.8
2.29 p. m. . . .	716.0	26.6	79	e.	1.3	1,550	636.4	15.7	. . . . . .	wsw.	. . . . . .
2.50 p. m. . . .	715.9	26.7	77	w.	2.2	1,117	669.2	19.7	. . . . . .	w.	. . . . . .
3.03 p. m. . . .	715.9	27.6	75	se.	2.2	526	715.9	27.6	75	se.	2.2
June 27:											
6.49 a. m. . . .	715.5	22.6	74	w.	5.8	526	715.5	22.6	74	w.	5.8
6.52 a. m. . . .	715.5	22.7	74	w	5.8	774	695.7	23.3	67	w.	10.7
7.03 a. m. . . .	715.5	23.0	71	w.	6.3	1,096	670.3	20.5	76	wnw.	20.2
7.08 a. m. . . .	715.5	23.2	70	w.	5.4	1,493	640.4	19.9	65	wnw.	14.8
7.25 a. m. . . .	715.5	24.4	68	wsw.	4.5	1,690	625.9	19.1	65	wnw.	8.6
7.43 a. m. . . .	715.5	25.0	69	sw.	2.2	1,824	616.2	17.5	65	wnw.	8.6
7.58 a. m. . . .	715.5	25.4	70	se.	2.7	1,824	616.2	17.1	66	wnw.	10.7
8.02 a. m. . . .	715.5	25.5	70	se.	2.7	1,690	625.9	17.3	69	wnw.	18.0
8.45 a. m. . . .	715.6	26.1	71	sw.	1.8	1,690	625.9	18.0	66	wnw.	10.8
8.51 a. m. . . .	715.6	26.2	71	sw.	1.8	1,824	616.2	17.3	64	wnw.	10.8
9.00 a. m. . . .	715.6	26.3	71	sw.	1.8	1,533	637.5	18.3	72	wnw.	18.0
9.06 a. m. . . .	715.6	26.5	71	w.	1.8	1,269	657.3	18.6	80	wnw.	16.2
9.16 a. m. . . .	715,6	27.2	66	sw.	1.8	526	715.6	27.2	66	sw.	1.8

June 25.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 4,100 m.; at maximum altitude, 3,400 m.

There were 6/10 to 10/10 St. from the southeast at the beginning of the flight, the direction shifting to the south-southeast, south, and southwest during the flight. There was 1/10 A.-St. from the west-southwest at 1.51 p. m.

Pressure was high over the Atlantic Ocean and low over the Missouri Valley and Kansas.

June 26.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 8/10 to 5/10 St.-Cu. from the west-southwest.

Pressure was low over Iowa and high off the Atlantic coast.

June 27.—Three kites were used; lifting surface, 20.9 sq. m. Wire out, 2,500 m. at maximum altitude.

Ci.-St. increased from 3/10 to 7/10 and A.-Cu. decreased from 4/10 to few. Both moved from the northwest.

Low pressure was central north of the lake region and high pressure over Florida.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind. Direction.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Wind. Direction.	Wind. Velocity.
1911.											
June 28:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.58 a. m....	715.4	22.7	84	nw.	6.3	526	715.4	22.7	84	nw.	6.3
9.13 a. m....	715.4	22.9	85	nw.	5.4	842	689.8	19.2	80	nw.	10.8
10.04 a. m....	715.5	24.0	79	nw.	5.4	1,307	653.6	15.3	91	nw.	8.1
10.43 a. m....	715.6	24.6	72	nw.	5.8	2,108	594.6	10.2	65	nw.	19.7
10.49 a. m....	715.6	25.0	74	nw.	6.3	2,443	571.2	9.5	40	nw.	18.0
11.23 a. m....	715.6	25.0	71	nw.	6.3	2,880	541.9	6.8	30	wnw.	14.6
12.00 m......	715.7	25.5	67	wnw.	4.5	3,227	519.6	4.5	28	wnw.	13.4
12.12 p. m....	715.7	25.6	67	wnw.	4.5	2,954	537.4	5.7	29	wnw.	16.6
12.18 p. m....	715.6	25.7	67	wnw.	4.5	2,531	565.6	8.1	37	wnw.	15.3
12.30 p. m....	715.6	26.0	68	wnw.	4.5	2,050	599.2	10.6	74	nw.	15.7
12.43 p. m....	715.6	25.0	69	wnw.	5.4	1,379	648.6	15.8	87	nw.	7.8
12.58 p. m....	715.5	26.0	59	wnw.	10.7	901	685.7	21.4	63	wnw.	11.7
1.05 p. m....	715.5	26.2	60	wnw.	9.8	526	715.5	26.2	60	wnw.	9.8
June 29:											
6.37 a. m....	718.4	15.4	87	nw.	8.0	526	718.4	15.4	87	nw.	8.0
6.40 a. m....	718.4	15.4	88	nw.	7.6	692	704.5	13.6	85	nnw.	13.5
6.52 a. m....	718.5	15.4	86	nw.	7.6	1,069	673.9	14.8	73	nw.	13.7
7.15 a. m....	718.6	15.9	86	nw.	5.8	1,720	624.4	15.8	15	nw.	8.6
9.32 a. m....	718.8	18.4	72	nw.	6.3	2,130	595.5	13.5	......	nw.	7.6
10.05 a. m....	718.8	18.8	70	nw.	7.2	2,726	554.5	8.6	......	nw.	8.8
10.13 a. m....	718.8	19.1	70	nw.	6.3	2,817	548.1	7.4	......	nw.	7.2
10.22 a. m....	718.8	19.3	69	nw.	7.6	2,375	577.7	10.7	......	nw.	7.0
10.32 a. m....	718.8	19.4	68	wnw.	7.6	1,853	614.7	13.3	......	nw.	5.6
10.38 a. m....	718.8	19.3	69	wnw.	8.0	1,629	631.1	15.5	......	nw.	5.2
11.00 a. m....	718.8	20.0	66	wnw.	7.2	1,204	663.8	12.0	26	nw.	11.0
11.07 a. m....	718.8	19.7	66	wnw.	5.8	800	696.3	15.2	72	nw.	8.6
11.13 a. m....	718.8	20.0	65	nw.	5.8	526	718.8	20.0	65	nw.	5.8
June 30:											
6.32 a. m....	720.0	15.3	82	nnw.	4.9	526	720.0	15.3	82	nnw.	4.9
6.40 a. m....	720.0	15.6	82	nnw.	4.9	783	698.5	15.1	68	nnw.	8.1
6.57 a. m....	720.1	15.9	82	nw.	5.4	1,125	671.1	15.6	55	nnw.	10.4
9.48 a. m....	720.2	18.6	73	wnw	7.2	1,526	640.4	13.3	42	n.	7.2
10.01 a. m....	720.2	19.6	72	wnw.	6.3	2,650	559.9	8.5	27	n.	10.2
10.03 a. m....	720.2	19.6	72	wnw.	6.7	2,824	548.2	8.9	23	n.	13.3
10.12 a. m....	720.2	20.0	70	nw.	6.3	3,159	526.7	7.3	16	n.	16.8
10.16 a. m....	720.2	20.2	69	nw.	7.2	2,826	548.2	8.9	23	n.	13.3
10.17 a. m....	720.2	20.1	68	nw.	7.2	2,652	559.9	8.5	30	n.	10.2
10.32 a. m....	720.1	19.9	69	nw.	7.2	1,525	640.4	14.2	37	n.	6.0
10.54 a. m....	720.1	20.6	67	nw.	7.2	1,282	659.1	14.1	56	nnw.	12.1
11.02 a. m....	720.1	20.6	67	nw.	6.3	863	692.4	16.0	71	nnw.	9.4
11.10 a. m....	720.2	20.6	68	nw.	6.7	526	720.2	20.6	68	nw.	6.7

June 28.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,500 m.

There were about 8/10 Ci. and Ci.-St. from the west. They were partially obscured by few to 8/10 Cu. from the northwest, altitude increasing from 1,000 m. to 1,500 m.

A ridge of high pressure extended from Wisconsin to the Gulf of Mexico. Pressure was low over Quebec.

June 29.—Seven kites were used; lifting surface, 44.6 sq. m. Wire out, 6,000 m.; at maximum altitude, 4,400 m.

There were a few St.-Cu. from the west-northwest.

Pressure was high over Lake Huron and low over Quebec.

June 30.—Eight kites were used; lifting surface, 52.9 sq. m. Wire out, 6,500 m.; at maximum altitude, 4,100 m.

There were 2/10 to 4/10 Ci. from the north-northwest.

High pressure, central over the lower Lakes, covered the eastern part of the country.

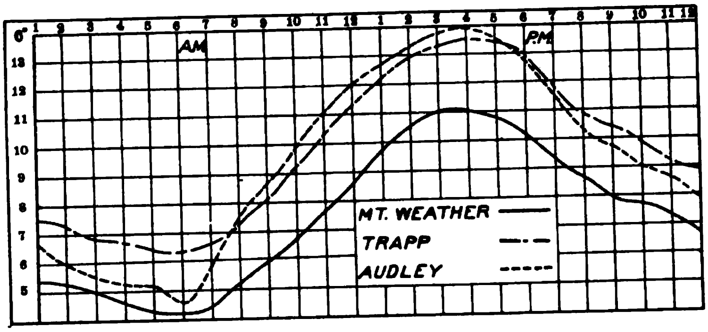


FIG. 4.—Mean hourly temperatures, April, 1911.

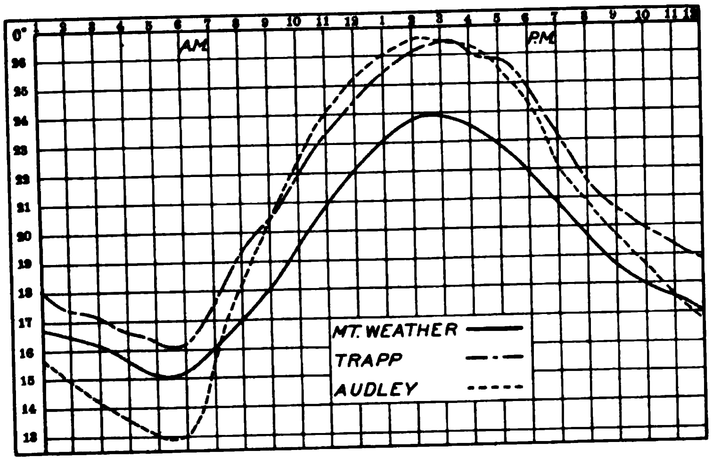


FIG. 5.—Mean hourly temperatures, May, 1911.

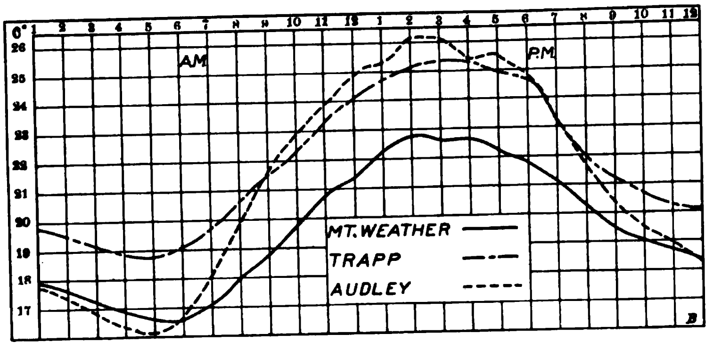


FIG. 6.—Mean hourly temperatures, June, 1911.

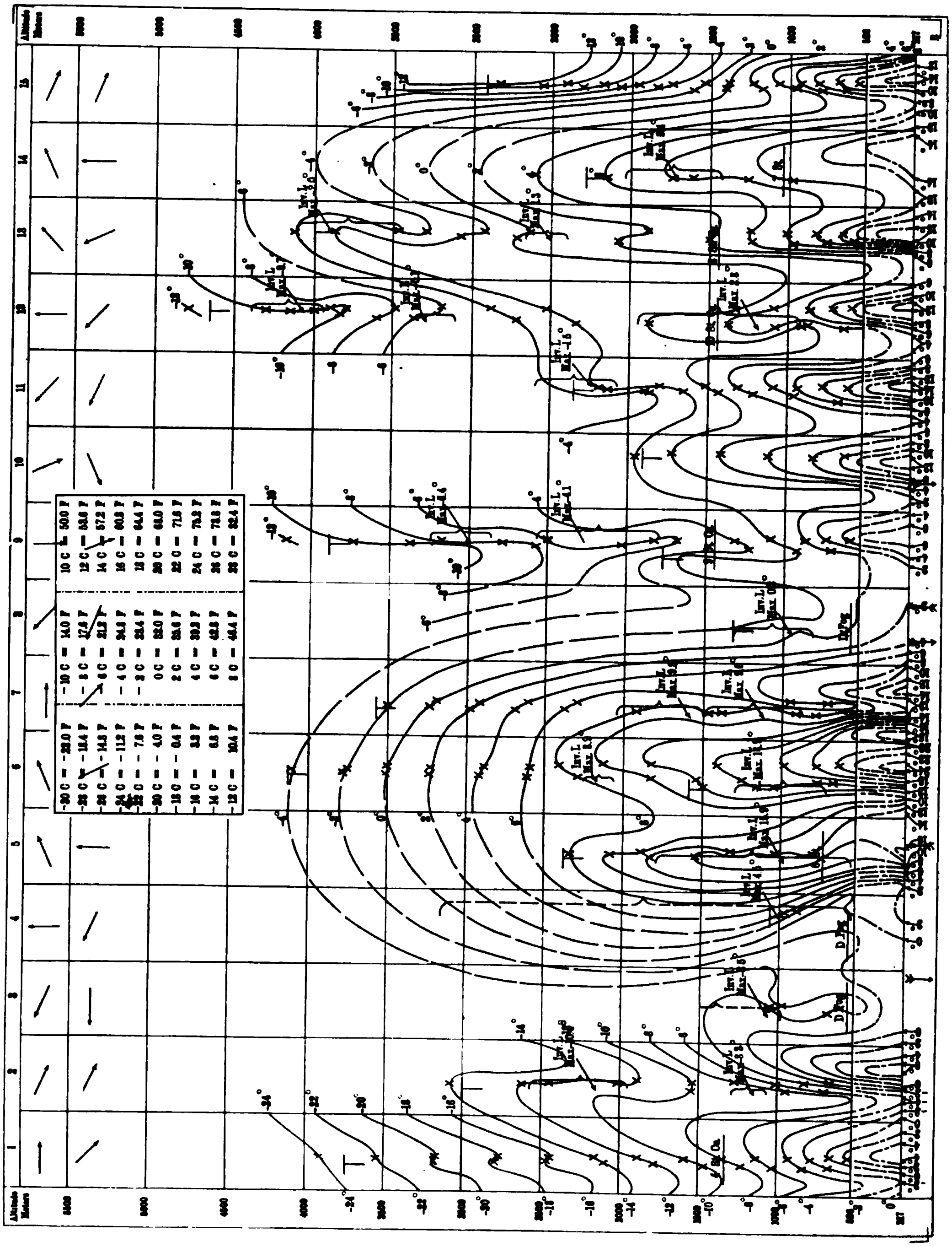
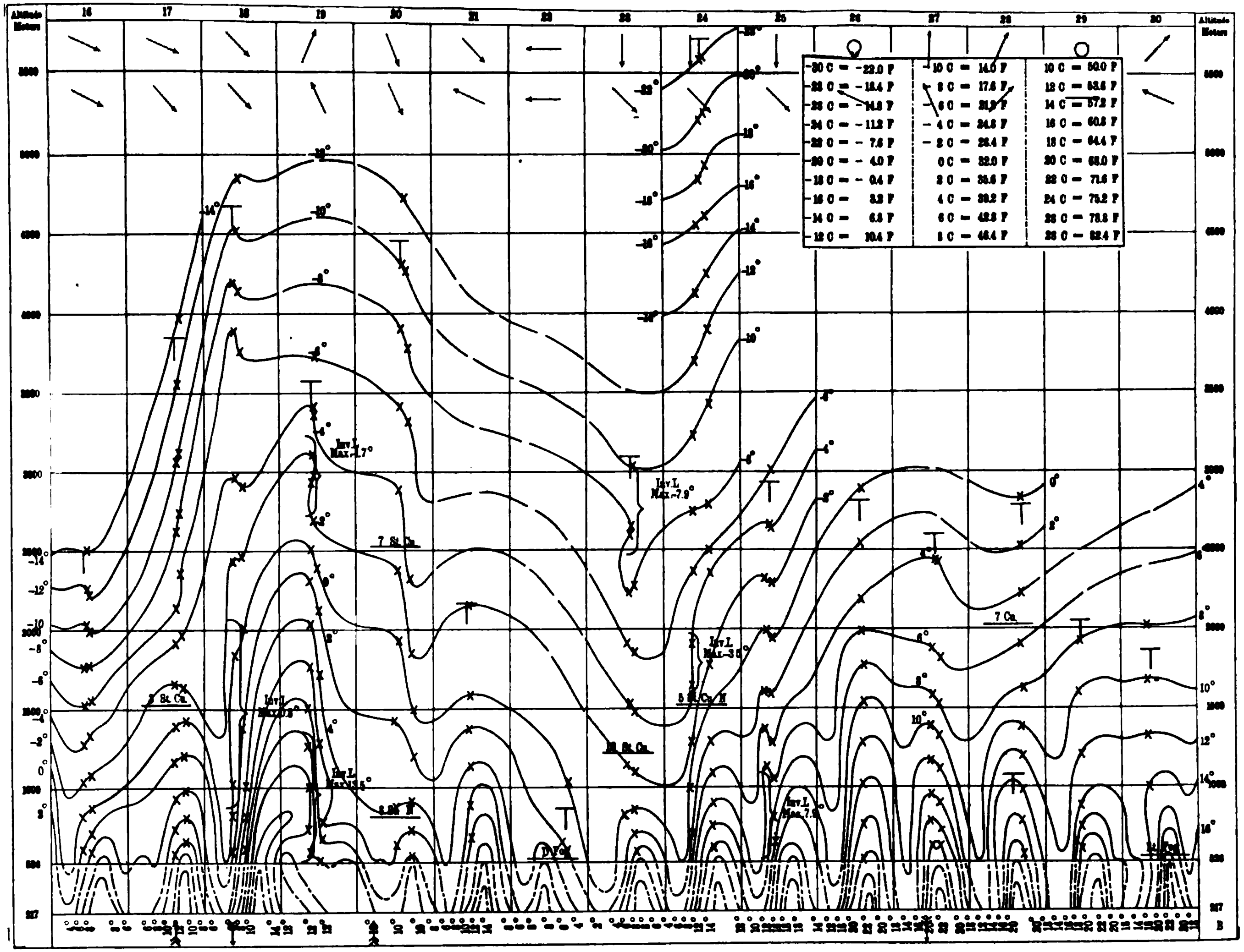


CHART VII.—Free air isotherms, April 1-15, 1911.



-30 C = -22.0 F
-28 C = -18.4 F
-26 C = -14.8 F
-24 C = -11.2 F
-22 C = - 7.6 F
-20 C = - 4.0 F
-18 C = - 0.4 F
-16 C = 3.2 F
-14 C = 6.8 F
-12 C = 10.4 F

-10 C = 14.0 F
- 8 C = 17.6 F
- 6 C = 21.2 F
- 4 C = 24.8 F
- 2 C = 28.4 F
0 C = 32.0 F
2 C = 35.6 F
4 C = 39.2 F
6 C = 42.8 F
8 C = 46.4 F

10 C = 50.0 F
12 C = 53.6 F
14 C = 57.2 F
16 C = 60.8 F
18 C = 64.4 F
20 C = 68.0 F
22 C = 71.6 F
24 C = 75.2 F
26 C = 78.8 F
28 C = 82.4 F

CHART VIII.—Free air isotherms, April 16–30, 1911.

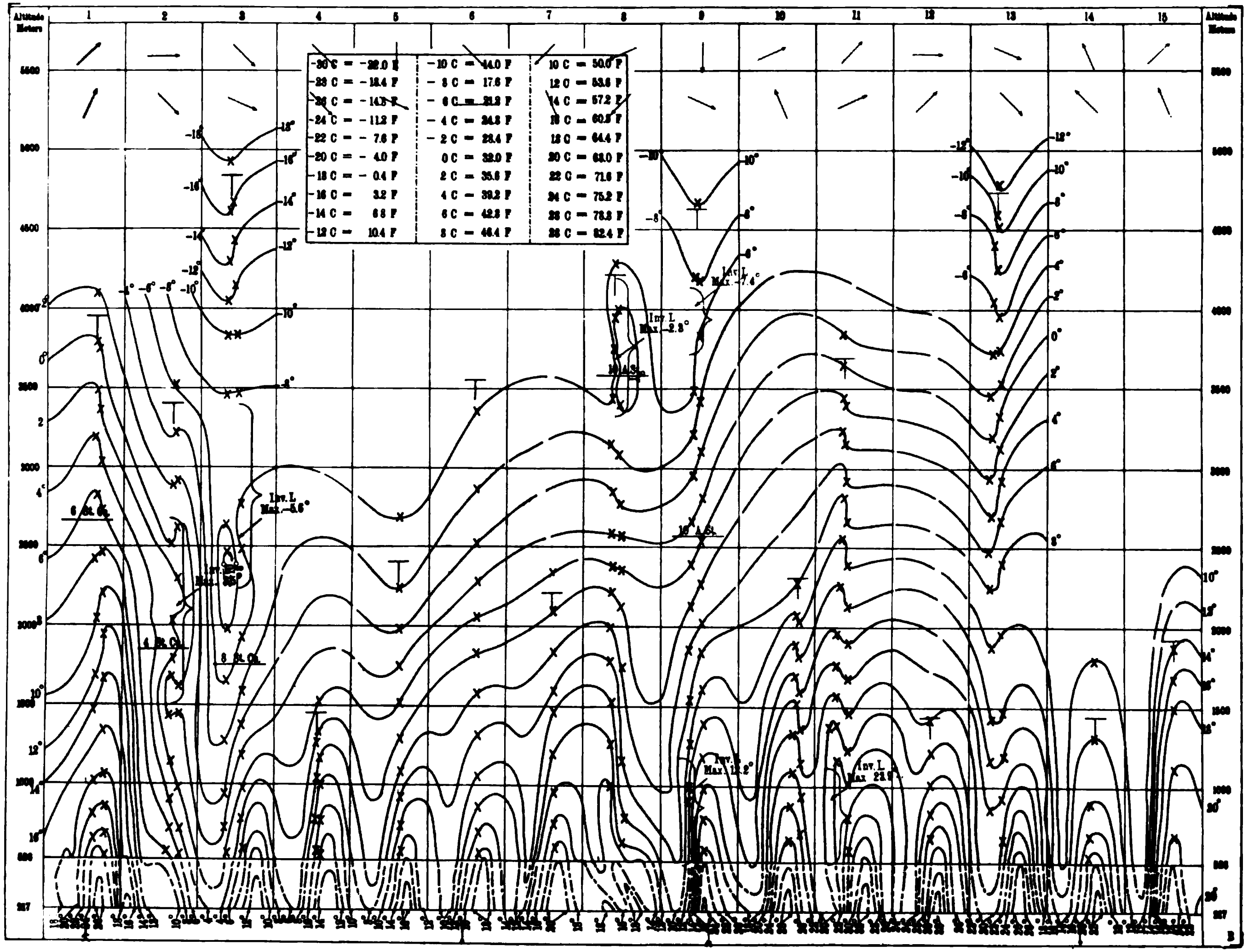


CHART IX.—Free air isotherms, May 1-15, 1911.

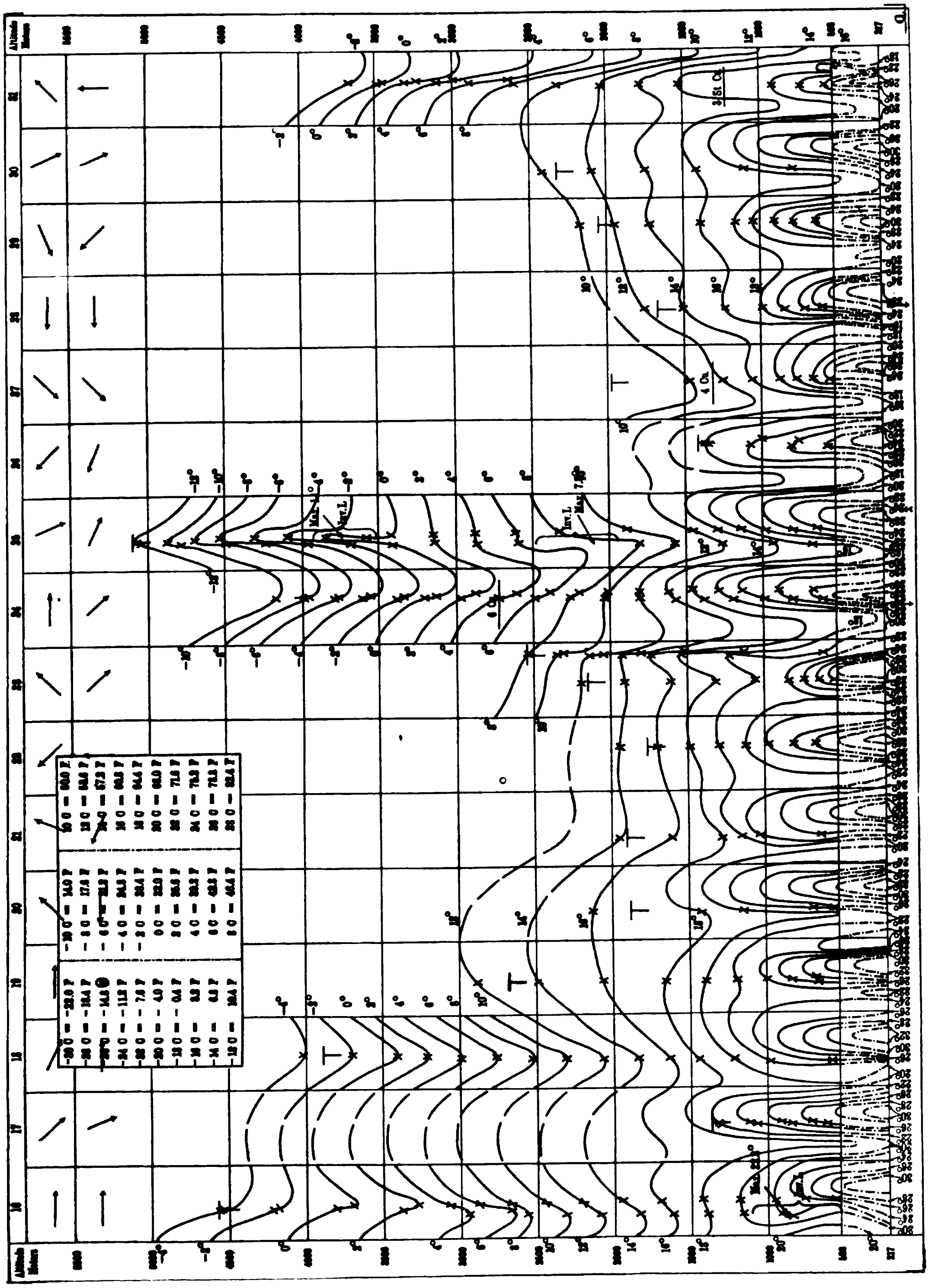


CHART X.—Free air isotherms, May 16-31, 1911.

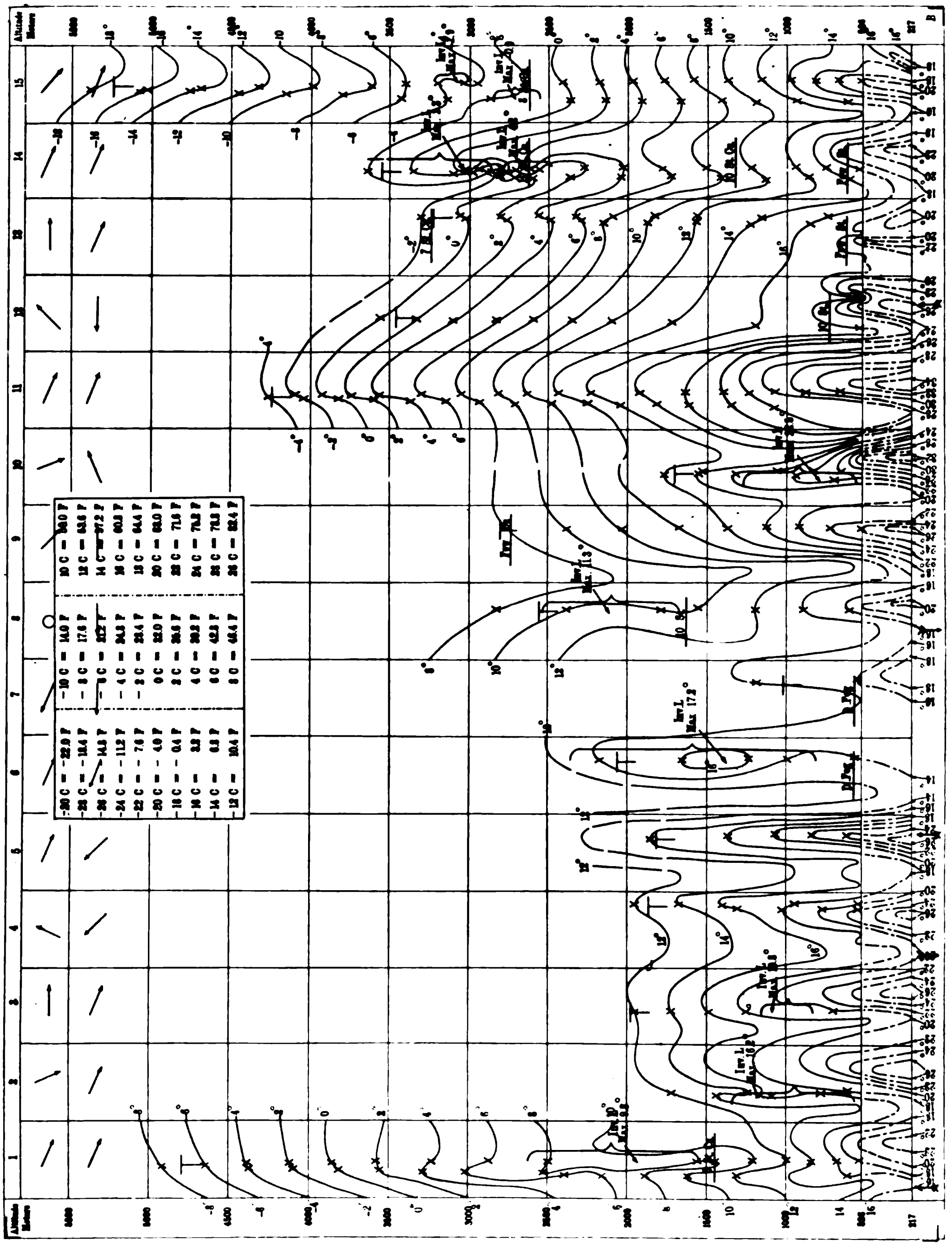


CHART XI.—Free air isotherms, June 1-15, 1911.

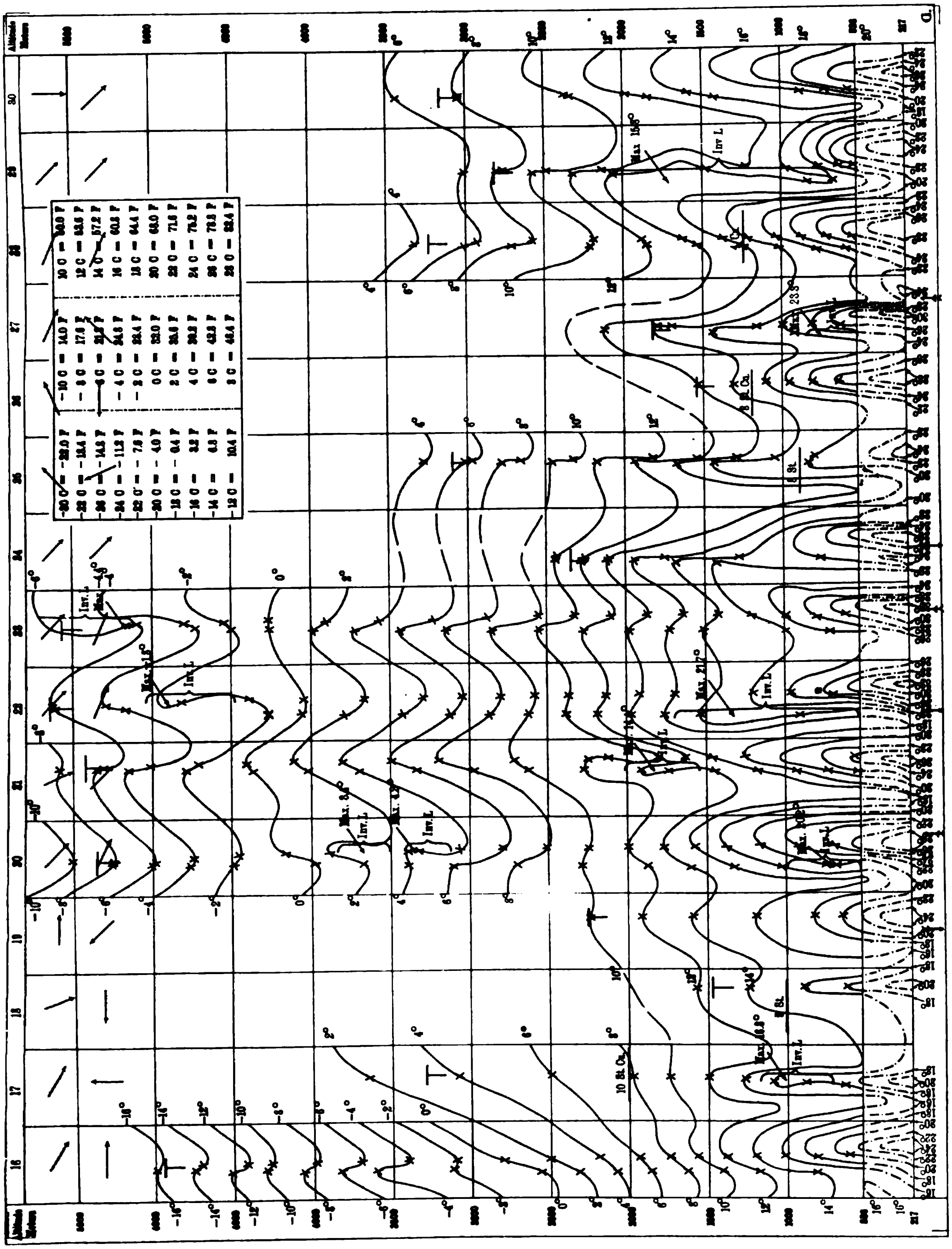


CHART XII.—Free air isotherms, June 16-30, 1911.

CONTENTS.

(VIII) [illegible] of temperature at [illegible] and [illegible] Mount Weather [illegible] [illegible]
(IX) Waves of pressure in the atmosphere [illegible] atmospheric [illegible] [illegible] and [illegible] [illegible]
(X) The [illegible] W. J. Humphreys [illegible]
(XI) The [illegible] W. J. Humphreys [illegible]
(XII) The height and temperature of the isothermal region [illegible] and under different conditions. W. J. Humphreys [illegible]
(XIII) New telescopic photography. [illegible] [illegible]
(XIV) Free-air data at Mount Weather for April, May, and June, 1911. W. R. Blair [illegible]

[illegible] will [illegible] the Weather Bureau.

[illegible] [illegible]

U. S. DEPARTMENT OF AGRICULTURE

[illegible] **BULLETIN** [illegible]

OF THE

MOUNT WEATHER OBSERVATORY

SOUNDING BALLOON NUMBER

[illegible]

WILLIS L. MOORE, Sc. D., LL. D.

[illegible]

[illegible]

BULLETIN

OF THE

MOUNT WEATHER OBSERVATORY.

Vol. 4, Part 4. SOUNDING BALLOON NUMBER. Closed January 1, 1912.
W. B. No. 478. CLEVELAND ABBE, Editor. Issued April 5, 1912.

(XV) FREE AIR DATA. SOUNDING BALLOON ASCENSIONS AT INDIANAPOLIS, OMAHA, AND HURON.

By the Aerial Section—WILLIAM R. BLAIR in charge.

PLACE, TIME, ETC., OF ASCENSIONS.

During the past two years, four series of sounding balloon ascensions have been made at inland points in the United States by the Mount Weather Observatory. In the first series, ascensions were made simultaneously at two places; in the others, all the balloons used in the series were sent up from one place. Tables I and II contain information of general interest about the four series and the individual ascensions respectively.

TABLE I.

Series	First.		Second.	Third.	Fourth.
Date	Sept. 25–Oct. 12, 1909.		May 6–May 22, 1910.	Aug. 9–Sept. 17, 1910.	Feb. 8–Mar. 4, 1911.
Starting place	Fort Omaha.	Indianapolis.	Fort Omaha.	Huron.	Fort Omaha.
Latitude	41° 19′	39° 46′	41° 19′	44° 21′	41° 19′
Longitude	95° 57′	86° 10′	95° 57′	98° 14′	95° 57′
Altitude	312 m	212 m	312 m	392 m	312 m
Number of ascensions	13	7	20	26	25
Number of instruments returned	12	7	16	24	22
Number of good records	12	6	16	23	22
Mean of highest altitude	13246 m	14042 m	6143 m	17617 m	18083 m
Highest ascension	24119 m	19443 m	25333 m	30486 m	24105 m

TABLE II.

Date.	Hour.	Balloons.			Starting point.	Landing point.	Horizontal distance balloon traveled.	Direction balloon traveled.	Highest altitude reached.	Lowest temperature recorded.
		Number.	Cubic contents.	Ascensional force.						
1909.			$m.^3$	kg.			km.		m.	°C.
Sept. 25	3:10 p.	1	3.6	1.0	Fort Omaha, Nebr..	Louisville, Nebr......	37	ssw.	9905	−56.8
27	2:58 p.	1	3.9	1.0	.....do.............	Syracuse, Nebr........	76	ssw.	12062	−63.2
28	3:30 p.	1	3.6	1.0	.....do.............	Rockport, Mo.........	106	se.	16952	−54.6
30	2:59 p.	1	3.6	1.0	.....do.............	Emerson, Iowa........	53	se.	11812	−65.2
Oct. 4	3:38 p.	1	3.6	1.0	.....do.............	Henderson, Iowa......	47	ne.	12439	−58.3
5	3:03 p.	1	3.6	1.0	.....do.............	Neola, Iowa..........	35	ene.	14286	−63.8
6	3:58 p.	2	7.2	1.5	.....do.............	Rockwell City, Iowa..	167	ne.	15934	−68.6
7	3:09 p.	2	7.2	1.5	.....do.............	Idagrove, Iowa........	126	n.	14939	−57.1
9	3:17 p.	2	7.3	1.5	.....do.............	Omaha, Nebr.........	1	s.	1254	4.6
10	2:59 p.	2	7.3	1.5	.....do.............	Bartlett, Iowa........	49	sse.	8045	−38.4
11	3:09 p.	2	7.3	1.5	.....do.............	Hurdland, Mo........	380	se.	17199	−54.8
12	2:33 p.	2	7.3	1.5	.....do.............	Palmyra, Mo..........	420	se.	23630	−52.4
Sept. 27	4:23 p.	1	3.6	0.8	Indianapolis, Ind...	Columbus, Ind........	65	sse.	6288	−35.2
30	3:50 p.	2	6.4	0.7	.....do.............	Terrace Park, Ohio....	168	se.	14605	−58.0
Oct. 4	3:35 p.	2	6.4	1.0	.....do.............	Patriot, Ind..........	154	se.	18307	−62.0
5	3:22 p.	2	6.4	0.9	.....do.............	Scottsburg, Ind.......	120	sse.	14482	−49.4
6	2:57 p.	2	6.4	1.2	.....do.............	Martinsville, Ind......	47	ssw.	19443	−65.0
1910.										
May 6	4:56 p.	1	4.1	0.9	Fort Omaha, Nebr..	Irvington, Nebr.......	8	w.	988	3.7
7	5:29 p.	1	4.2	1.1	.....do.............	Elmwood, Nebr.......	64	ssw.	5692	−14.8
8	5:18 p.	1	4.2	1.1	.....do.............	Pacific Junction, Iowa.	34	sse.	4092	− 1.6
9	5:06 p.	1	4.0	1.1	.....do.............	Red Oak, Iowa.......	69	ese.	6070	−12.3
10	5:02 p.	1	4.2	1.1	.....do.............	Avoca, Iowa..........	49	ene.	4450	− 8.0
11	5:18 p.	1	3.6	0.8	.....do.............	Shenandoah, Iowa....	83	se.	4856	−11.3
12	5:01 p.	1	4.2	1.0	.....do.............	Westboro, Mo.........	104	se.	7979	−24.4
13	5:31 p.	1	3.6	0.8	.....do.............	Anderson, Iowa.......	62	sse.	5653	−15.6
15	4:59 p.	1	3.8	0.9	.....do.............	Shelby, Iowa.........	47	ne.	5162	−10.5
17	4:54 p.	1	4.0	0.9	.....do.............	Malvern, Iowa........	45	se.	2759	0.5
18	7:22 a.	1	3.6	0.7	.....do.............	Carson, Iowa..........	53	e.	5665	− 7.7
19	7:07 a.	1	3.6	0.7	.....do.............	Woodbine, Iowa......	53	nne.	3777	− 3.3
19	5:20 p.	1	4.0	1.0	.....do.............	Des Moines, Iowa.....	200	e.	25333	−60.2
20	6:55 a.	1	3.6	0.8	.....do.............	Carson, Iowa..........	53	e.	4761	− 6.4
21	5:19 p.	1	3.8	0.8	.....do.............	Minden, Iowa.........	41	ne.	5575	−11.6
22	5:46 p.	1	3.8	0.8	.....do.............	Glenwood, Iowa......	33	sse.	5019	−13.4
Aug. 10	5:16 p.	1	4.5	1.2	Huron, S. Dak......	Flandreau, S. Dak....	121	ese.	11867	−52.6
11	5:00 p.	1	4.5	1.2	.....do.............	Doon, Iowa...........	201	se.	14582	−47.7
12	4:43 p.	1	4.6	1.2	.....do.............	White, S. Dak........	131	e.	23200	−55.8
13	4:42 p.	1	4.5	1.2	.....do.............	Brookings, S. Dak....	121	e.	12861	−45.8
14	4:32 p.	1	4.8	1.4	.....do.............	Castlewood, S. Dak...	105	ene.	9390	−34.0
Sept. 1	4:55 p.	1	6.2	1.0	.....do.............	.....do..............	105	ene.	30486	−54.9
2	4:58 p.	1	6.2	1.0	.....do.............	Island, Lake, Minn...	190	e.	18978	−56.6
3	5:02 p.	1	6.2	1.0	.....do.............	Argo, S. Dak.........	125	e.	16446	−62.3
4	4:55 p.	1	6.7	1.1	.....do.............	Watertown, S. Dak...	100	ene.	26806	−52.4
5[1]	11:08 a.	1	4.8	1.5	.....do.............	Graceville, Minn......	200	ne.	11063	−36.0
5[2]	5:07 p.	1	6.7	1.1	.....do.............	Brookings, S. Dak....	125	e.	24193	−56.7
6	6:28 p.	1	6.2	1.0	.....do.............	Albee, S. Dak.........	153	ene.	16408	−53.0
7	4:40 p.	1	6.2	1.0	.....do.............	Castlewood, S. Dak...	105	ene.	19359	−58.8
8	4:44 p.	1	6.2	1.0	.....do.............	Colman, S. Dak.......	123	ese.	20317	−59.5
9	4:45 p.	1	6.0	0.8	.....do.............	Montrose, S. Dak.....	113	se.	13332	−44.2
10	4:47 p.	1	6.2	1.0	.....do.............	Aurora, S. Dak.......	125	e.	22630	−54.7
11[1]	7:15 a.	1	6.7	1.2	.....do.............	Dawson, Minn........	185	ene.	24899	−56.7
11[2]	5:00 p.	1	6.2	1.0	.....do.............	Renville, Minn........	247	e.	19267	−68.9
12	....	...	.....	.....	.....do.............	....	.....	....	....	......
13	4:51 p.	1	6.2	1.2	.....do.............	Ruthton, Minn.......	165	e.	17258	−58.4
14	4:46 p.	1	6.5	1.3	.....do.............	Chester, S. Dak.......	115	ese.	16046	−57.6
15	4:34 p.	1	6.5	1.2	.....do.............	Salem, S. Dak........	100	se.	5671	−13.6
16	4:42 p.	1	6.5	1.2	.....do.............	Madison, S. Dak......	100	ese.	19756	−62.1
17[1]	7:01 a.	1	5.1	1.8	.....do.............	Howard, S. Dak......	70	ese.	10294	−39.4

[1] First ascension.

[2] Second ascension.

TABLE II—Continued.

Date.	Hour.	Balloons.			Starting point.	Landing point.	Horizontal distance balloon traveled.	Direction balloon traveled.	Highest altitude reached.	Lowest temperature recorded.
		Number.	Cubic contents.	Ascensional force.						
1911.			*m.*³	*kg.*			*km.*		*m.*	°*C.*
Feb. 8	4:45 p.	1	5.4	1.8	Fort Omaha, Nebr	Anita, Iowa	102	ene.	13804	−47.4
9	3:50 p.	1	5.3	1.5	do	Grant City, Mo	160	se.	21260	−57.9
10	3:40 p.	1	5.0	0.8	do	Dallas Center, Iowa	175	ene.	19614	−54.3
11	3:39 p.	1	5.1	1.0	do	De Kalb, Iowa	175	ese.	18025	−54.1
12	3:37 p.	1	5.2	1.3	do	Perry, Iowa	170	ene.	17571	−56.9
13	3:50 p.	1	5.2	1.2	do	Livermore, Iowa	235	ne.	4548	− 8.2
14	3:55 p.	1	5.2	1.2	do	Bagley, Iowa	144	ene.	21544	−56.7
15	4:04 p.	1	5.2	1.1	do	Ogden, Iowa	185	ene.	21070	−60.4
16	3:38 p.	1	5.2	1.2	do	Eldora, Iowa	270	ene.	14248	−61.5
17	3:37 p.	1	5.2	1.2	do	Colo, Iowa	240	ene.	20272	−56.6
18	3:36 p.	1	5.3	1.6	do	Bagley, Iowa	144	ene.	22187	−58.8
19		1			do					
20		1			do					
21	3:52 p.	1	5.2	1.3	do	Springfield, Nebr	35	sw.	17716	−61.6
22	3:42 p.	1	5.2	1.1	do	Council Bluffs, Iowa	19	se.	17755	−58.3
23	3:50 p.	1	5.1	0.9	do	Murray, Nebr	45	s.	19871	−57.0
24	3:51 p.	1	5.3	1.4	do	Elkhorn, Iowa	82	ene.	13193	−44.3
25	3:32 p.	1	5.3	1.4	do	Fort Dodge, Iowa	204	ne.	24105	−47.4
26	4:05 p.	1	5.2	1.2	do	Ankeny, Iowa	206	ene.	21601	−56.0
27	3:55 p.	1	5.1	1.0	do	Harvey, Iowa	257	e.	19597	−62.6
28	3:48 p.	1	5.2	1.2	do	Leighton, Iowa	271	e.	14369	−57.4
Mar. 1					do					
2	3:37	1	5.2	1.1	do	Lenox, Iowa	124	ese.	18861	−48.5
3	3:54	1	5.2	1.2	do	Decatur City, Iowa	192	ese.	19050	−53.9
4	3:39	1	5.2	1.2	do	Murray, Iowa	173	e.	17575	−53.9

THE BALLOONS—THEIR ASCENSIONAL RATES.

The balloons used in the second series were of thin rubber and had been in stock for some time. With one exception they burst at low altitudes. The balloons used in all other series were of thicker rubber and were used as soon after their manufacture as was possible. In fact the break in the third series was on account of the arrival later than expected of most of the balloons to be used in the series. Larger balloons were used in the third and fourth than in the first series. The first, third, and fourth series average well, and the ascension of September 1, 1910, in the third series, is the highest aerial sounding of which the recording instrument returned a complete record.

Hydrogen gas, produced electrolytically, was used in all ascensions except those at Indianapolis. (See this Bulletin, Vol. III, p. 127.) In the first, second, and fourth series at Omaha the gas was furnished by the Signal Corps of the United States Army, while in the third series gas was made at Mount Weather, compressed in steel cylinders, and shipped to Huron.

The use of the same type of balloon in the last two series of ascensions is accompanied by marked uniformity of behavior as to ascensional rate. In the curve on the left of figure 1, the means of the ascensional rates found in 20 ascensions (each of which reached an altitude of 18 or more kilometers) are plotted as abscissæ with the altitudes as ordinates. The curve on the right in figure 1 shows the mean temperatures observed in the same 20 ascensions. The numerical data are contained in Table III.

TABLE III.

Altitude above surface.	Rate of ascent.	Mean temperature.	Altitude above surface.	Rate of ascent.	Mean temperature.
Kilometers.	*m. p. s.*	*°C.*	*Kilometers.*	*m. p. s.*	*°C.*
1	2.98	5.42	10	3.98	−47.08
2	2.94	2.36	11	4.13	−50.26
3	2.98	− 2.32	12	4.26	−52.56
4	3.03	− 8.26	13	4.57	−53.76
5	3.19	−15.00	14	4.87	−54.06
6	3.33	−21.76	15	4.99	−54.86
7	3.42	−28.60	16	4.92	−55.21
8	3.51	−35.31	17	4.55	−55.05
9	3.68	−41.94	18	4.30	−54.18

The apparent relation between the two curves is probably accounted for by a lag in the temperature of the gas in the balloon behind that of the surrounding air. A lag may be expected from the fact that a mass of hydrogen rising to the 15-kilometer level and expanding adiabatically would cool but little more than 10° C. while the change in air temperature is about 65° C. from the earth's surface to the 15-kilometer level. The relatively greater heating by the sun's rays of the rubber envelope as it reaches higher levels is no doubt instrumental in maintaining a larger difference in temperature between the gas in the balloon and that outside at these levels. The heat conductivity of the rubber probably remains about halfway in value between that of the inside and outside gases, but the air in immediate contact with the balloon and that entrained by it must also become, relatively to the surrounding air, warmer at the higher levels. All of the ascensions considered in figure 1 and Table III were made in the daytime. At night the lag in temperature would be much less, probably not noticeable. (Dines: Phil. Trans., Royal Soc. of London, A, 211, p. 260.)

The effect of this lag in temperature on the relative densities of the gases inside and outside the balloon is not taken account of by Mallock in his note on "The ascent of meteorological balloons." (Mallock: Proc. Royal Soc. of London, A, 80, p. 530.) It seems to be of importance, at least if the ascension is made when the sun is shining on the balloon. The variation in the ascensional rate of a balloon owing to the difference in temperature between the contained and surrounding gases, and to other factors taken account of by Mallock in the note referred to above, is much too great to be ignored when the altitudes are computed from the ascensional rate.

THE INSTRUMENTS.

The instruments used in the first series and the method by which they were calibrated are described in this bulletin (Vol. III, p. 127). For succeeding series, these instruments were made lighter by the removal of the heavier temperature element.

The calibrations of the hygrographs were made as for the first series.

For the calibration of the pressure and temperature elements an air-tight chamber (57 by 47 by 63 centimeters inside measure) capable of containing 14 instruments was constructed. The temperature and pressure inside of the chamber were determined as previously. The temperature in the chamber was controlled by circulating a liquid, usually alcohol, through a system of tubing distributed about the inside walls. The alcohol was kept at any desired temperature by the use of carbon dioxide or liquid air, usually both in the order named. The details of construction of the chamber are shown in figure 2.

The inside temperature and pressure were under excellent control from room temperature down to −45° or −50° C. and up again. To bring the temperature up, water was circulated through the jacket (No. 4 in the diagram) at the desired rate.

The air circulation produced in the chamber by the fan was carefully explored and the standard thermometer and temperature elements of the instruments placed with reference to their ventilation.

The instruments to be used in a series of ascensions were calibrated just before the time set for the series as follows: A table was prepared from available data for the season in which the series of ascensions was to be made, showing the pressures and temperatures likely to be experienced simultaneously by the instrument. This table was followed in the calibration. Temperatures and pressures actually experienced by the meteorographs in the ascensions do not differ from the mean conditions by enough to introduce any serious error in the pressure element owing to temperature.

THE DATA.

The data obtained in the four series of ascensions have been tabulated with interpolations at the 500-meter levels up to 5 kilometers above sea level and at the kilometer levels above the 5-kilometer level. These tables follow the introductory notes. Tables for the first series, at Omaha and Indianapolis, have already been published. (This bulletin, Vol. III, p. 135.) They are reprinted here with the interpolations. Figures 3 to 8, inclusive, for this series (this bulletin, Vol. III, pp. 131–134) are also reprinted with the same numbers and titles as previously. The odd-numbered figures represent observations made at Omaha, the even numbered those made at Indianapolis.

Similar figures have been made for the three succeeding series of ascensions: Figures 9–11, 12–14, 15–17 for the second, third, and fourth series, respectively. In figures 3, 4, 9, 12, and 15, the curves show the separate observations of the temperature gradient. The surface temperature is marked at the foot of each curve. In figures 5, 6, 10, 13, and 16, the free-air isotherms 5° C. apart are charted from the observations made in the different series. In figures 7, 8, 11, 14, and 17, the plots represent the horizontal projections of the paths of the balloons in the different series. The date and the altitude at which the balloon disappeared are marked at the end of each projection; also the altitudes at which sharp changes in wind direction have been observed. The points projected correspond to the computed levels in the tables. These points are connected by lines which approximate a horizontal projection of the balloon's path.

Weather notes are recorded in the tables at the times of observation. The general pressure distribution during the four series is shown in figures 18 to 27, inclusive. In these figures the paths of anticyclones are marked in solid red lines, those of cyclones in dashed red lines. The successive positions of a given disturbance are indicated by the numbers showing the day of the month and the time of the observation. The time of observation is either 8 a. m. or 8 p. m., seventy-fifth meridian time. Each date is entered twice, the first time for the morning and the second time for the evening observation.

SUMMARY AND DISCUSSION OF THE DATA.

In summarizing the data contained in the above-described tables and figures, it was found that the number and distribution of the observations would not warrant grouping by quadrants and seasons in high and in low pressure areas. The data obtained by the Blue Hill Meteorological Observatory in several series of free-balloon ascensions at St. Louis and in individual ascensions at Pittsfield, Mass., have therefore been combined with those obtained by the Mount Weather Observatory for the purpose of the summary. This addition increases the number of observations from 79 to 138 and materially helps the seasonal distribution. The distribution of the observations in the different quarters of high and low pressure areas is still not good and that grouping has been deferred for the present.

The distribution of the work of reducing the data included in this summary among the writer and his first five assistants has been such that each table and figure represents the work of all six. The boundary lines between the groups of data have been adhered to strictly. It is hoped that in this way most, if not all, errors of a personal nature have been eliminated or avoided.

TEMPERATURE DATA.

The temperature data have been grouped with reference to rising and falling air pressure at the earth's surface. Figures 28 and 29 and Tables IV and V contain the number of observations, the mean temperatures, and the mean vertical temperature gradient at the different levels by seasons in each of the groups, respectively. Figures 30 and 31 and Table VI contain the seasonal and annual means, all observations considered. In figure 31 the extremes of the temperature observations entering into each mean are shown at the level of the mean. A possible latitude effect in the minimum free-air temperature and the altitude at which it is found is not taken into account in this summary. The Blue Hill instruments record somewhat lower minimum temperatures above St. Louis than do the Mount Weather instruments above Omaha or Huron.

TABLE IV.—*Temperatures over rising air pressure at the surface.*

Altitude above sea level.	Spring.			Summer.			Autumn.			Winter.		
	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.
		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
500 meters	23	15.0	......	6	23.3	......	31	11.9	......	16	− 0.8	......
750 meters	23	13.2	0.72	6	21.3	0.80	29	9.8	0.84	16	− 2.6	0.72
1000 meters	23	11.3	0.76	6	19.3	0.80	29	7.8	0.80	16	− 3.9	0.52
1250 meters	22	9.6	0.68	6	17.1	0.88	27	6.2	0.64	16	− 4.6	0.28
1500 meters	22	8.0	0.64	6	14.9	0.88	27	4.9	0.52	16	− 5.1	0.20
1750 meters	22	6.6	0.56	6	12.9	0.80	27	3.6	0.52	16	− 5.3	0.08
2000 meters	21	5.4	0.48	6	11.7	0.48	27	2.7	0.36	16	− 6.1	0.36
2250 meters	21	4.3	0.44	6	10.7	0.40	27	1.5	0.48	16	− 7.1	0.36
2500 meters	21	3.0	0.52	6	9.7	0.40	27	0.5	0.40	16	− 8.1	0.40
2750 meters	21	1.8	0.48	6	8.1	0.64	27	− 0.6	0.44	16	− 9.1	0.40
3000 meters	21	0.5	0.52	6	6.5	0.64	27	− 1.6	0.40	16	−10.1	0.40
3250 meters	21	− 1.0	0.60	6	5.4	0.44	27	− 2.9	0.52	16	−11.3	0.48
3500 meters	21	− 2.5	0.60	6	4.0	0.56	27	− 4.4	0.60	16	−12.5	0.48
3750 meters	20	− 3.9	0.56	6	2.8	0.48	27	− 5.9	0.60	16	−13.9	0.56
4000 meters	20	− 5.3	0.56	6	1.6	0.48	27	− 7.4	0.60	16	−15.3	0.56
4250 meters	18	− 6.5	0.48	5	0.4	0.48	27	− 9.1	0.68	15	−16.8	0.60
4500 meters	18	− 8.0	0.60	5	− 0.8	0.48	27	−10.7	0.64	15	−18.6	0.72
5000 meters	15	−10.7	0.54	5	− 2.9	0.42	27	−13.8	0.62	13	−21.7	0.62
6000 meters	12	−16.3	0.56	5	− 9.3	0.64	27	−20.8	0.70	13	−28.1	0.64
7000 meters	10	−23.4	0.71	5	−16.8	0.75	24	−27.9	0.71	13	−34.8	0.67
8000 meters	10	−30.7	0.73	5	−24.9	0.81	24	−35.6	0.77	13	−41.4	0.66
9000 meters	9	−38.5	0.78	5	−32.0	0.71	21	−42.7	0.71	13	−46.3	0.49
10000 meters	8	−45.2	0.67	4	−38.2	0.62	21	−48.6	0.59	13	−49.5	0.32
11000 meters	6	−48.1	0.29	3	−44.0	0.58	19	−53.0	0.44	12	−50.8	0.13
12000 meters	6	−47.1	−0.10	3	−48.1	0.41	14	−56.1	0.31	12	−51.7	0.09
13000 meters	5	−47.8	0.07	1	−47.4	−0.07	11	−58.4	0.23	12	−52.1	0.04
14000 meters	5	−49.0	0.12	......	......	......	11	−58.5	0.01	11	−52.6	0.05
15000 meters	5	−50.0	0.10	......	......	......	10	−58.0	−0.05	9	−53.7	0.11
16000 meters	3	−49.6	−0.04	......	......	......	8	−57.6	−0.04	9	−54.7	0.10
17000 meters	2	−50.4	0.08	......	......	......	8	−57.3	−0.03	9	−54.5	−0.02
18000 meters	1	−50.4	0.00	......	......	......	7	−56.0	−0.13	8	−53.9	−0.06
19000 meters	1	−50.4	0.00	......	......	......	6	−53.8	−0.22	7	−53.8	−0.01
20000 meters	......	......	......	......	......	......	4	−49.5	−0.43	6	−53.0	−0.08
21000 meters	......	......	......	......	......	......	3	−47.5	−0.20	4	−52.7	−0.03
22000 meters	......	......	......	......	......	......	3	−44.9	−0.26	1	−52.2	−0.05
23000 meters	......	......	......	......	......	......	3	−41.5	−0.34	1	−52.1	−0.01
24000 meters	......	......	......	......	......	......	3	−38.3	−0.32	1	−51.9	−0.02
25000 meters	......	......	......	......	......	......	1	−34.9	−0.34	......	......	......

TABLE V.—*Temperatures over falling air pressure at the surface.*

Altitude above sea level.	Spring.			Summer.			Autumn.			Winter.		
	Number of observations.	Mean temperature.	*Δt* per 100 m.	Number of observations.	Mean temperature.	*Δt* per 100 m.	Number of observations.	Mean temperature.	*Δt* per 100 m.	Number of observations.	Mean temperature.	*Δt* per 100 m.
		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*		°*C.*	°*C.*
500 meters	17	18.4	......	7	26.6	......	27	19.0	......	11	1.9	......
750 meters	17	16.7	0.68	7	24.7	0.76	27	17.3	0.68	11	0.8	0.44
1000 meters	17	14.9	0.72	7	22.8	0.76	27	15.7	0.64	11	0.6	0.08
1250 meters	17	13.2	0.68	7	21.2	0.64	27	14.0	0.68	11	1.1	−0.10
1500 meters	17	11.8	0.56	7	19.7	0.60	27	12.6	0.56	11	1.3	−0.08
1750 meters	17	10.4	0.56	6	17.7	0.80	27	11.1	0.60	11	0.8	0.10
2000 meters	17	8.9	0.60	6	15.7	0.80	27	9.7	0.56	11	− 0.4	0.48
2250 meters	17	7.3	0.64	6	13.9	0.72	26	8.1	0.64	11	− 1.6	0.48
2500 meters	17	5.8	0.60	6	12.9	0.40	26	6.8	0.52	11	− 2.7	0.44
2750 meters	17	4.3	0.60	6	11.4	0.60	26	5.7	0.44	11	− 3.6	0.36
3000 meters	17	2.8	0.60	6	9.7	0.68	26	4.4	0.52	11	− 4.6	0.40
3250 meters	17	1.3	0.60	6	8.1	0.64	25	2.8	0.64	11	− 5.8	0.48
3500 meters	16	− 0.2	0.60	6	6.4	0.68	25	1.3	0.60	11	− 6.9	0.44
3750 meters	16	− 1.5	0.52	6	4.7	0.68	25	− 0.3	0.64	11	− 8.1	0.48
4000 meters	16	− 2.9	0.56	6	3.1	0.64	25	− 1.8	0.60	11	− 9.5	0.56
4250 meters	15	− 4.4	0.60	6	1.5	0.64	25	− 3.4	0.64	11	−11.0	0.60
4500 meters	15	− 6.0	0.64	6	− 0.1	0.64	25	− 5.1	0.68	11	−12.6	0.64
5000 meters	12	− 8.9	0.58	6	− 2.8	0.54	24	− 8.5	0.68	11	−15.7	0.62
6000 meters	9	−14.7	0.58	6	− 9.2	0.64	22	−15.8	0.73	10	−22.3	0.66
7000 meters	8	−22.0	0.73	6	−16.2	0.70	21	−23.0	0.72	9	−29.9	0.76
8000 meters	8	−30.2	0.82	6	−23.7	0.75	20	−30.8	0.78	9	−37.2	0.73
9000 meters	8	−38.7	0.85	6	−31.1	0.74	20	−38.4	0.76	9	−43.7	0.65
10000 meters	8	−46.1	0.74	5	−38.8	0.77	19	−44.9	0.65	7	−48.3	0.46
11000 meters	7	−50.4	0.43	4	−45.2	0.64	19	−50.4	0.55	7	−51.1	0.28
12000 meters	7	−53.3	0.29	4	−49.6	0.44	18	−54.8	0.44	7	−53.2	0.21
13000 meters	4	−53.9	0.06	4	−52.5	0.29	15	−57.0	0.22	7	−54.5	0.13
14000 meters	3	−53.7	−0.02	2	−50.3	−0.22	14	−58.2	0.12	7	−56.0	0.15
15000 meters	2	−55.0	0.13	1	−45.7	−0.46	13	−58.6	0.04	6	−57.2	0.12
16000 meters	1	−55.3	0.03	......	......	......	12	−57.6	−0.10	6	−57.2	0.00
17000 meters	1	−55.2	−0.01	......	......	......	7	−56.1	−0.15	6	−57.1	−0.01
18000 meters	......	......	......	......	......	......	5	−54.7	−0.14	4	−56.7	−0.04
19000 meters	......	......	......	......	......	......	4	−53.3	−0.14	3	−56.6	−0.01
20000 meters	......	......	......	......	......	......	3	−51.7	−0.16	2	−55.5	−0.11
21000 meters	......	......	......	......	......	......	3	−50.0	−0.17	2	−55.0	−0.05
22000 meters	......	......	......	......	......	......	3	−48.5	−0.15	1	−55.0	0.00
23000 meters	......	......	......	......	......	......	2	−47.5	−0.10	......	......	......
24000 meters	......	......	......	......	......	......	2	−46.2	−0.13	......	......	......
25000 meters	......	......	......	......	......	......	2	−44.5	−0.17	......	......	......
26000 meters	......	......	......	......	......	......	2	−42.5	−0.20	......	......	......
27000 meters	......	......	......	......	......	......	1	−41.2	−0.13	......	......	......
28000 meters	......	......	......	......	......	......	1	−40.8	−0.04	......	......	......
29000 meters	......	......	......	......	......	......	1	−41.2	0.04	......	......	......
30000 meters	......	......	......	......	......	......	1	−41.5	0.03	......	......	......

TABLE VI.—*Mean temperature, seasonal and annual.*

Altitude above sea level.	Spring.			Summer.			Autumn.			Winter.			Year.		
	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.	Number of observations.	Mean temperature.	Δt per 100 m.
		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.		°C.	°C.
500 meters......	40	16.4	......	13	25.1	......	58	15.2	......	27	0.3	......	138	13.6	......
750 meters......	40	14.6	0.72	13	23.1	0.80	56	13.2	0.80	27	− 1.2	0.60	136	11.8	0.72
1000 meters......	40	12.8	0.72	13	21.1	0.80	56	11.4	0.72	27	− 2.1	0.36	136	10.2	0.64
1250 meters......	39	11.1	0.68	13	19.3	0.72	54	9.8	0.64	27	− 2.3	0.08	133	8.8	0.56
1500 meters......	39	9.5	0.64	13	17.5	0.72	54	8.4	0.56	27	− 2.1	0.08	133	7.6	0.48
1750 meters......	39	8.1	0.56	12	15.5	0.80	54	7.0	0.56	27	− 2.8	0.12	132	6.4	0.48
2000 meters......	38	6.7	0.56	12	13.9	0.64	54	5.8	0.48	27	− 3.8	0.40	131	5.2	0.48
2250 meters......	38	5.4	0.52	12	12.5	0.56	53	4.4	0.56	27	− 4.9	0.44	130	3.9	0.52
2500 meters......	38	4.0	0.56	12	11.5	0.40	53	3.2	0.48	27	− 5.9	0.40	130	2.7	0.48
2750 meters......	38	2.6	0.56	12	9.9	0.64	53	2.1	0.44	27	− 6.9	0.40	130	1.5	0.48
3000 meters......	38	1.2	0.56	12	8.3	0.64	53	0.9	0.48	27	− 7.9	0.40	130	0.3	0.48
3250 meters......	38	− 0.3	0.60	12	6.9	0.56	52	− 0.5	0.56	27	− 9.1	0.48	129	− 1.1	0.56
3500 meters......	37	− 1.8	0.60	12	5.3	0.64	52	− 2.0	0.60	27	−10.3	0.48	128	− 2.5	0.56
3750 meters......	36	− 3.2	0.56	12	3.8	0.60	52	− 3.5	0.60	27	−11.7	0.56	127	− 4.0	0.60
4000 meters......	36	− 4.6	0.56	12	2.4	0.56	52	− 5.0	0.60	27	−13.1	0.56	127	− 5.4	0.56
4250 meters......	33	− 6.0	0.56	11	1.0	0.56	52	− 6.7	0.68	26	−14.6	0.60	122	− 6.9	0.60
4500 meters......	33	− 7.5	0.60	11	− 0.4	0.56	52	− 8.3	0.64	26	−16.3	0.68	122	− 8.5	0.64
5000 meters......	24	−10.6	0.62	11	− 2.8	0.48	51	−11.5	0.64	24	−19.4	0.62	110	−11.6	0.62
6000 meters......	21	−16.3	0.57	11	− 9.2	0.64	49	−18.7	0.72	23	−25.9	0.65	104	−18.2	0.66
7000 meters......	18	−23.5	0.72	11	−16.4	0.72	45	−25.8	0.71	22	−33.0	0.71	96	−25.3	0.71
8000 meters......	18	−31.2	0.77	11	−24.2	0.78	44	−33.5	0.77	22	−39.9	0.69	95	−32.8	0.75
9000 meters......	17	−39.3	0.81	11	−31.5	0.73	41	−40.9	0.74	22	−45.5	0.56	91	−39.9	0.71
10000 meters......	16	−46.4	0.71	9	−38.5	0.70	40	−47.1	0.62	20	−49.2	0.37	85	−45.8	0.59
11000 meters......	13	−50.0	0.36	7	−44.6	0.61	38	−52.1	0.50	19	−51.0	0.18	77	−49.9	0.41
12000 meters......	13	−51.1	0.11	7	−48.8	0.42	32	−55.9	0.38	19	−52.3	0.13	71	−52.6	0.27
13000 meters......	9	−51.7	0.06	5	−51.0	0.22	26	−58.1	0.22	19	−53.0	0.07	59	−54.1	0.15
14000 meters......	8	−52.4	0.07	2	−48.8	−0.22	25	−58.8	0.07	18	−53.9	0.09	53	−54.7	0.06
15000 meters......	7	−53.5	0.11	1	−44.2	−0.46	23	−58.8	0.00	15	−55.0	0.11	46	−55.1	0.04
16000 meters......	4	−53.3	−0.02	....	......	......	20	−58.1	−0.07	15	−55.6	0.06	39	−54.9	−0.02
17000 meters......	3	−53.8	0.05	....	......	......	15	−57.3	−0.08	15	−55.4	−0.02	33	−54.5	−0.04
18000 meters......	1	−53.8	0.00	....	......	......	12	−55.9	−0.14	12	−54.9	−0.05	25	−53.6	−0.09
19000 meters......	1	−53.8	0.00	....	......	......	10	−54.0	−0.19	10	−54.8	−0.01	21	−52.6	−0.10
20000 meters......	....	......	......	....	......	......	7	−50.9	−0.31	8	−53.9	−0.09	15	−50.7	−0.19
21000 meters......	....	......	......	....	......	......	6	−49.0	−0.19	6	−53.5	−0.04	12	−49.6	−0.11
22000 meters......	....	......	......	....	......	......	6	−47.0	−0.20	2	−53.3	−0.02	8	−48.0	−0.16
23000 meters......	....	......	......	....	......	......	5	−44.6	−0.24	1	−53.2	−0.01	6	−46.0	−0.20
24000 meters......	....	......	......	....	......	......	5	−42.1	−0.25	1	−53.0	−0.02	6	−43.9	−0.21
25000 meters......	....	......	......	....	......	......	3	−39.8	−0.23	....	......	......	3	−41.6	−0.23
26000 meters......	....	......	......	....	......	......	2	−37.8	−0.20	....	......	......	2	−39.6	−0.20
27000 meters......	....	......	......	....	......	......	1	−36.5	−0.13	....	......	......	1	−38.3	−0.13
28000 meters......	....	......	......	....	......	......	1	−36.1	−0.04	....	......	......	1	−37.9	−0.04
29000 meters......	....	......	......	....	......	......	1	−36.5	0.04	....	......	......	1	−38.3	0.04
30000 meters......	....	......	......	....	......	......	1	−36.8	0.03	....	......	......	1	−38.6	0.03

A comparison of figures 28 and 29, or of Tables IV and V, shows lower air temperatures over rising than over falling air pressure at the earth's surface at all levels up to 9 kilometers in the spring, 10 kilometers in the summer, 14 kilometers in the autumn, and 11 kilometers in the winter months. Above these levels the air temperatures are decidedly higher over rising than over falling surface air pressures in the spring, summer, and winter months. In the autumn months the temperatures shown in both tables are about the same from the 14 to the 20 kilometer level, but from there up are higher over rising than over falling surface air pressure. In figure 33 the curves shown in figures 28 and 29 have been superposed to facilitate their comparison. These observations are not in accord with the theory that makes radiation from the lower strata of the atmosphere responsible for the marked decrease with altitude of the vertical temperature gradient in the vicinity of 11 kilometers above sea level. (This bulletin, Vol. II, p. 13, par. 2.) The warmer upper-air temperatures are found above the colder lower-air temperatures and the colder upper-air temperatures above the warmer lower ones.

The decrease of temperature with altitude is greater up to about the 1.2 kilometer level over rising than over falling surface air pressure. From this level up to about the 3.5 kilometer level, the decrease in temperature with altitude is less over rising than over falling surface air pressure. From the latter level up to about 11 kilometers, the temperature decrease with altitude is about the same whatever the trend of the air pressure at the earth's surface. In this region the decrease of temperature with altitude becomes markedly less, the change occurring at lower levels over rising than over falling surface air pressure and apparently somewhat more abruptly. The changes just described as taking place in decrease of temperature with altitude at about the levels 1.2 and 3.5 kilometers are subject to variation in altitude with the seasons, both being higher in the summer months. The seasonal variation of the change at 11 kilometers is discussed later in connection with the data contained in Table IX.

Although there is a decided decrease in the vertical temperature gradient at about the 11-kilometer level, the coldest mean temperature is found at the 15 to 16 kilometer level. (Figs. 30 and 31 and Table VI.) There are not many spring and summer observations represented in this mean, but if the observations made in the United States in these seasons were supplemented by all those published in the Veröffentlichungen to date, neither the level nor the value of the minimum mean temperature would be much changed. The tendency would be toward a lower minimum mean temperature at a higher level. The autumn observations show a sharp minimum at 15 kilometers, and the winter observations show almost as sharp a minimum at 16 kilometers. Spring observations show a minimum at 17 or 18 kilometers. Those of summer usually show two minima, one at about 11 kilometers and another at 17 or 18 kilometers. Temperature conditions are nearly isothermal between these two minima. Above the second minimum there seems to be a decided increase in temperature with altitude. The decrease in the vertical temperature gradient at about the 11-kilometer level appears to be sharpest in the summer, less sharp in spring, winter, and autumn, respectively.

HUMIDITY.

In addition to the relative humidity published in the general tables, the absolute humidity in terms of "Weight in grams per cubic meter" has been tabulated for the third and fourth series. Tables VII and VIII show the values obtained. Within the limits of error of the hair hygrometer, these data may be considered fairly representative of the seasons in which they were obtained.

TABLE VII.—*Absolute humidity in grams per cubic meter.*

[Observations made in the third series of ascensions.]

	392	500	1000	1500	2000	2500	3000	3500	4000
1910.									
Aug. 10	13.253	12.706	10.212	8.271	7.130	6.031	5.104	4.244	3.128
11	13.413	12.345	9.536	7.202	4.615	3.437	3.010	2.558	2.032
12	16.876	16.601	14.607	13.276					
13	14.066	13.896	12.542	10.964	7.688	5.243	3.828	3.001	2.282
14	13.211	12.448	10.092	9.579	8.198	6.200	4.077	2.964	2.414
Sept. 1	12.440	12.542	12.408	10.752	8.149	4.595	1.809	0.613	0.277
2	11.705	11.241	9.620	6.918	4.595	2.900	2.221	1.685	1.334
3	10.955	10.760	9.695	8.692	7.637	6.477	5.176	3.813	2.491
4	14.807	13.955	9.992	7.468	5.817	4.900	4.048	3.333	2.532
5	9.530								
5	8.585	8.594	8.188	7.464	6.569	5.545	4.267	2.928	2.123
6	8.858	8.571	6.916	5.672	4.449	3.803	2.906	1.825	1.162
7	10.144	10.894	9.699	8.450	5.486	3.013	2.012	1.501	1.202
8	4.937	4.665	3.478	2.979	2.519	2.310	2.372	2.166	1.626
9	5.922	5.610	4.386	3.753	4.289	3.855	3.062	1.784	1.142
10	9.361	9.108	7.647	6.472	5.884	5.093	3.510	2.312	1.621
11	5.360	5.156	4.554	7.045	7.489	5.117	3.721	2.730	2.272
11	6.036	5.816	4.804	3.873	3.039	3.648	3.251	2.941	3.074
13	4.963	4.788	3.895	3.207	3.377	3.513	3.380	2.623	2.040
14	8.988	8.872	8.133	7.604	7.954	8.007	6.772	5.093	3.807
15	12.265	11.969	10.349	8.323	5.933	3.377	2.452	2.337	1.914
16	15.194								
17	12.627	12.212	9.911	7.003	5.799	4.722	3.801	3.115	2.551
Means	10.587	10.131	8.603	7.379	5.831	4.589	3.539	2.678	2.051

	13000	14000	15000	16000	17000	18000	19000	20000	21000
1910.									
Aug. 10	0.030								
11	0.024								
12									
13									
14									
Sept. 1	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003
2	0.012								
3	0.010	0.006	0.003	0.003					
4	0.023	0.023	0.022						
5									
5	0.017	0.012	0.008	0.005	0.005	0.005	0.008	0.010	0.008
6	0.012	0.011	0.008	0.007					
7	0.009	0.006	0.005	0.004	0.004	0.006	0.014		
8									
9									
10	0.010	0.014	0.013	0.011	0.010	0.011	0.012	0.018	0.023
11	0.023	0.033	0.040	0.041	0.033	0.047	0.057	0.062	0.072
11	0.000	0.006	0.008	0.008	0.009	0.014	0.017		
13	0.021	0.016	0.016	0.018	0.019	0.015			
14	0.020	0.020							
15									
16									
17									
Means	0.015	0.013	0.012	0.011	0.012	0.014	0.018	0.023	0.026

TABLE VII.—*Absolute humidity in grams per cubic meter*—Continued.

	4500	5000	6000	7000	8000	9000	10000	11000	12000
1910.									
Aug. 10	2.470	1.986	0.808	0.375	0.261	0.154	0.090	0.048	0.020
11	1.571	1.181	0.670	0.356	0.176	0.113	0.061	0.043	0.031
12	......	......	......	......	......	......	......	......	......
13	1.535	1.088	0.647	0.388	0.208	0.151	0.090	0.056	0.044
14	1.896	1.532	1.126	0.619	0.301	0.161	......	......	......
Sept. 1	0.156	0.153	0.107	0.062	0.032	0.017	0.006	0.003	0.001
2	1.167	0.929	0.383	0.172	0.137	0.069	0.029	0.015	0.017
3	1.427	0.749	0.479	0.378	0.319	0.148	0.057	0.026	0.017
4	1.837	1.333	0.700	0.282	0.172	0.069	0.043	0.032	0.026
5	......	......	......	......	......	......	......	......	......
5	1.524	1.132	0.553	0.224	0.116	0.063	0.029	0.021	0.029
6	0.796	0.563	0.249	0.135	0.079	0.041	0.024	0.016	0.012
7	0.953	0.812	0.472	0.210	0.096	0.061	0.028	0.014	0.009
8	1.213	0.875	0.462	0.227	0.142	0.065	0.031	......	......
9	0.700	0.456	0.233	0.111	0.077	0.054	......	......	......
10	1.117	0.778	0.388	0.236	0.122	0.094	0.043	0.022	0.012
11	1.869	1.535	1.340	0.903	0.498	0.310	0.134	0.070	0.039
11	3.218	2.409	1.131	0.848	0.468	0.305	0.133	0.040	0.008
13	1.632	1.311	0.978	0.600	0.307	0.205	0.093	0.043	0.026
14	2.942	2.255	1.282	0.670	0.313	0.190	0.077	0.046	0.026
15	1.480	0.983	......	......	......	......	......	......	......
16	......	......	......	......	......	......	......	......	......
17	2.087	1.610	1.010	0.556	0.257	0.155	0.072	......	......
Means	1.580	1.194	0.685	0.387	0.215	0.128	0.061	0.033	0.021

	22000	23000	24000	25000	26000	27000	28000	29000	30000
1910.									
Aug. 10	......	......	......	......	......	......	......	......	......
11	......	......	......	......	......	......	......	......	......
12	......	......	......	......	......	......	......	......	......
13	......	......	......	......	......	......	......	......	......
14	......	......	......	......	......	......	......	......	......
Sept. 1	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.003
2	......	......	......	......	......	......	......	......	......
3	......	......	......	......	......	......	......	......	......
4	......	......	......	......	......	......	......	......	......
5	......	......	......	......	......	......	......	......	......
5	0.010	0.013	0.017	......	......	......	......	......	......
6	......	......	......	......	......	......	......	......	......
7	......	......	......	......	......	......	......	......	......
8	......	......	......	......	......	......	......	......	......
9	......	......	......	......	......	......	......	......	......
10	0.026	......	......	......	......	......	......	......	......
11	0.097	0.159	0.267	......	......	......	......	......	......
11	......	......	......	......	......	......	......	......	......
13	......	......	......	......	......	......	......	......	......
14	......	......	......	......	......	......	......	......	......
15	......	......	......	......	......	......	......	......	......
16	......	......	......	......	......	......	......	......	......
17	......	......	......	......	......	......	......	......	......
Means	0.034	0.058	0.096	0.004	0.003	0.003	0.003	0.003	0.003

TABLE VIII.—*Absolute humidity in grams per cubic meter.*

[Observations made in the fourth series of ascensions.]

	312	500	1000	1500	2000	2500	3000	3500	4000	4500
1911.										
Feb. 8	4.581									
9	1.976	1.802	1.300	1.023	0.875	0.713	0.611	0.504	0.380	0.283
10	3.511	3.334	2.925	2.161	1.987	1.570	1.124	0.839	0.569	0.355
11	5.419	5.097	4.198	4.436	2.748	1.553	1.216	0.696	0.508	0.353
12	7.073	6.856	6.745	4.703	2.632	1.268	0.458	0.254	0.147	0.128
13	5.391	4.920	6.267	6.733	5.934	4.865	4.268	3.730	3.254	2.398
14	5.134	4.842	4.189	3.697	2.510	1.556	1.287	0.925	0.679	0.514
15	5.920	5.704	4.898	5.057	3.277	1.838	1.162	0.769	0.519	0.386
16	5.724	5.530	5.234	4.918	4.373	3.521	2.864			
17	4.814									
18	3.677	3.334	2.480	1.899	1.365	0.982	0.789	0.635	0.991	1.111
21	1.548	1.153	0.832	0.737	0.577	0.417	0.317	0.243	0.212	0.175
22	2.127	1.771	1.041	0.827	0.563	0.438	0.336	0.239	0.180	0.136
23	1.929	1.476	0.685	0.475	0.361	0.265	0.190	0.174	0.147	0.124
24	1.987	1.819	1.444	1.081	0.835	0.636	0.505	0.370	0.240	0.154
25	1.408	1.180	0.776	0.568	0.705	0.563	0.472	0.365	0.283	0.205
26	1.885	1.627	1.044	0.711	0.399	0.367	0.375	0.324	0.223	0.151
27	1.135	0.874	0.423	0.527	0.467	0.487	0.500	0.516	0.373	0.254
28	1.180	1.072	0.785	0.685	0.619					
Mar. 2	2.998	2.679	1.969	1.553	1.351	1.154	0.889	0.785	0.657	0.507
3	3.739	3.469	2.776	2.093	2.024	1.792	1.393	1.092	0.922	0.697
4	2.915	2.651	2.110	1.754	2.088	1.809	1.377	1.321	1.069	0.872
Means	3.458	3.060	2.606	2.282	1.784	1.358	1.054	0.765	0.631	0.489

	15000	16000	17000	18000	19000	20000	21000	22000	23000	24000
1911.										
Feb. 8										
9	0.010	0.008	0.008	0.008	0.009	0.010	0.10			
10	0.007	0.007	0.007	0.007	0.007					
11	0.005	0.005	0.006	0.007						
12	0.001	0.001	0.001							
13										
14	0.009	0.010	0.007	0.007	0.007	0.009	0.010			
15	0.004	0.003	0.004	0.004	0.004	0.004	0.005			
16										
17										
18	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007		
21	0.007	0.006	0.005							
22	0.003	0.004	0.005							
23	0.005	0.005	0.004	0.004	0.004					
24										
25	0.013	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.008	0.008
26	0.004	0.004	0.004	0.004	0.003	0.004	0.003			
27	0.007	0.005	0.006	0.009	0.008					
28										
Mar. 2	0.022	0.023	0.025	0.025						
3	0.018	0.018	0.018	0.018						
4	0.021	0.020	0.020							
Means	0.009	0.008	0.008	0.009	0.006	0.007	0.007	0.008	0.008	0.008

TABLE VIII.—*Absolute humidity in grams per cubic meter*—Continued.

	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000
1911.										
Feb. 8	......	......	......	......	......	......	......	......	......	......
9	0.201	0.126	0.052	0.023	0.010	0.008	0.008	0.010	0.013	0.010
10	0.248	0.113	0.061	0.027	0.014	0.010	0.008	0.007	0.007	0.007
11	0.259	0.122	0.069	0.066	0.043	0.033	0.025	0.019	0.011	0.007
12	0.123	0.066	0.035	0.034	0.020	0.010	0.005	0.001	0.001	0.001
13	......	......	......	......	......	......	......	......	......	......
14	0.404	0.246	0.132	0.083	0.038	0.027	0.019	0.015	0.016	0.013
15	0.296	0.155	0.083	0.049	0.023	0.013	0.007	0.005	0.005	0.007
16	......	......	......	......	......	......	......	0.014	0.009	0.011
17	......	......	......	......	......	......	......	......	......	......
18	1.175	0.707	0.215	0.123	0.063	0.025	0.008	0.009	0.008	0.008
21	0.131	0.085	0.037	0.016	0.012	0.013	0.015	0.012	0.010	0.008
22	0.098	0.081	0.033	0.015	0.007	0.004	0.005	0.005	0.005	0.004
23	0.094	0.055	0.022	0.012	0.008	0.008	0.008	0.008	0.006	0.004
24	0.099	0.054	0.021	0.017	0.009	0.006	0.001	0.001	0.004	......
25	0.146	0.080	0.049	0.024	0.011	0.013	0.013	0.013	0.013	0.012
26	0.127	0.065	0.036	0.019	0.013	0.007	0.009	0.009	0.011	0.007
27	0.181	0.172	0.097	0.046	0.023	0.010	0.007	0.006	0.007	0.008
28	......	......	......	0.190	0.091	0.046	0.022	0.013	0.011	0.012
Mar. 2	0.397	0.198	0.138	0.077	0.030	0.029	0.024	0.027	0.027	0.027
3	0.484	0.225	0.140	0.083	0.041	0.023	0.020	0.019	0.018	0.018
4	0.748	0.310	0.173	0.070	0.031	0.021	0.020	0.020	0.021	0.021
Means	0.307	0.168	0.081	0.054	0.027	0.017	0.012	0.011	0.011	0.010

The great difference in the amount of moisture near the earth's surface in the two tables is remarkable; also the fact that at the 4.5 kilometer level the absolute humidity is greater in the autumn months than at the 2.5 kilometer level in the winter months. A rather persistent inversion of temperature at about the 1-kilometer level on February 11 to 15, 1911 (see figs. 15a and 16a) is accompanied by increasing absolute humidity with altitude on the 13th and 15th and by higher than usual absolute humidities at these levels on the 11th, 12th, 14th, and 16th.

After passing above the lower moist stratum there is no marked change in the mean moisture content of the air aside from its decrease with altitude and temperature until the minimum temperature is reached. Table VII, nearly all autumn observations, shows a minimum of absolute humidity at the 16-kilometer level and Table VIII shows a similar minimum between the 16 and 17 kilometer levels. The dropping out of the ascensions of February 11, March 2 and 3, at the 18-kilometer level accounts for the apparent minimum at 19 kilometers. These minimum values of the absolute humidity are coincident with the minimum temperatures noted above. A review of all the observations of humidity that have been published in the Veröffentlichungen to date supports the evidence given by Tables VII and VIII.

While the accuracy of the record made by the hair hygrometer at these very low temperatures is variously estimated, the general results shown in Tables VII and VIII are in keeping with what we know of the relation between temperature and absolute humidity. If dryness of the air be a condition for the existence of ozone, however produced (this bulletin, Vol. II, pp. 14 and 15), then a greater proportion of ozone should be expected at about the 16-kilometer level—i. e., the level of minimum temperature—than either above (as far as the explorations extend) or below. These observations constitute a more or less potent objection (depending on instrumental accuracy) to the assumption of dryness and consequent presence of ozone in regions of relatively high rather than in regions of minimum temperature in this stratum of the atmosphere.

WIND DIRECTION AND VELOCITY.

The wind direction and velocity at different heights during the balloon ascensions are computed from observations, made every minute, of the angles of azimuth and elevation of the balloon, and the altitude of the balloon. In the great majority of the ascensions the balloon disappeared at or below the 6-kilometer level. When these lower wind observations are arranged in groups as were the kite observations of 1907–1910 (this bulletin, Vol. IV, pp. 50 and 57), they show the same general distribution of direction about the centers of high and low pressure as did the kite observations. But all groups are not represented and most that are contain only a few observations. The publication of tables and figures to show such grouping is therefore deferred until more data have been acquired.

The observations of wind direction and velocity at all altitudes are of great interest, but clouds and haze render them impossible at the higher levels on most days. Of the 79 balloons sent up in the four series, from which good records were returned, 46 passed through a surface, which for convenience will be called "S," including all points in the neighborhood of 10 kilometers above sea level at which the vertical temperature gradient becomes 1° C. or less per kilometer. Of these 46 balloons, 12 were followed with the theodolite until they burst. The dates of these 12 are September 28 and October 5, 1909, at Omaha; October 4, 5, and 6, 1909, at Indianapolis; September 4, 7, and 16, 1910, at Huron; and February 8, 21, 22, and 23, 1911, at Omaha. There is no characteristic change apparent either in wind direction or velocity at the surface S. Such a change does occur at the points of minimum temperature. At these points the velocity usually drops markedly. The change in direction, either clockwise or counterclockwise, with altitude, is usually such as to bring the wind at these levels into the west quarter. The mean of the directions just above the minima of temperature is WNW. and the mean velocity is approximately 19 meters per second. The decided northerly component in these winds opposes the idea that there is warm air moving from the south at these levels.

The directions range from S. 58 W. to N. 9 W. and the velocities from 5.6 to 41.9 meters per second. The directions vary somewhat above these levels and the velocities usually decrease. In some cases, e. g., February 23, 1911, where there are two minima of temperature, the wind velocity drops at the first minimum but rises with lowering temperature until the second minimum is reached. The ascensions of October 4, 1909, and February 21, 1911, did not reach minima of temperature. The sharp change in direction and velocity between the 9 and 10 kilometer level on the latter date is exceptional in that it accompanies a very small uniform vertical temperature gradient. The ascension of September 4, 1910, shows a sharp change in direction between the 24 and 25 kilometer levels, the wind going from S. 57 W. to N. 23 E.

In considering the data given of wind direction and velocity, it should be borne in mind that the theodolite must be set on the balloon and read quickly, and that a slight error in the reading may result in apparent sharp changes in wind direction and velocity. It is highly probable that some of the sharp changes noticeable in the wind data should be smoothed to some extent. Such smoothing would be legitimate, because the errors are local while the data in general must be correct.

Wind data at these altitudes can be obtained on clear days only. This fact, together with the fact that there are but 12 observations, stands in the way of drawing general conclusions from them. These with other available data, however, point to the conclusion that the surface of minimum temperature rather than the surface S (nearly that of maximum change with altitude in the vertical temperature gradient) is the surface at which convection begins to weaken decidedly. There is some evidence of local convection above the surface of minimum temperature, e. g., the ascension of February 23, 1911.

The difference in altitude between these two surfaces, as shown by the temperature data above discussed, is approximately 5 kilometers. So far as they go, these data do not support the assumption that convection is practically absent above the lower of these two surfaces. Yet this general assumption is frequently made and is a fundamental one in the theories of De Bort and of Humphreys (this bulletin, Vol. II, p. 12, par. 2), accounting for the great decrease in the vertical temperature gradient at the lower of the two surfaces.

ALTITUDE AND TEMPERATURE OF THE SURFACE S.

This surface is discussed here because it has been used by others and because it is nearly coincident with the surface of greatest change in the vertical temperature gradient with altitude. The latter surface, all observations made in this country considered, is found at about 10.5 kilometers above sea level and has a mean temperature of −48° C.

The 46 ascensions passing through the surface S have been studied to determine whether or not there is any characteristic variation in the altitude or in the air temperature of the surface with variations of air pressure at the earth's surface and with the change of seasons. The air pressure at the center of the disturbance (high or low pressure area) which had passed the base station, the air pressure at the base station, and the air pressure at the center of the advancing disturbance were compared. The location of the base station with reference to the centers of the two disturbances near the time of any ascension was expressed in hundredths of the difference in pressure between the two centers. In figure 32 these locations are plotted with the altitude of the surface S. The observations made in the months April to September are marked "×," while those made October to March are marked "⊙."

The extreme points at which the surface S was observed differ in altitude by about as much as the lower one is above sea level, and points in nearly the same position with reference to the base station pressure may have altitudes differing by 4 or 5 kilometers. One should keep such facts as these in mind when he consults mean values and should be restrained by them from basing conclusions on too few or poorly distributed observations.

The scheme of plotting gives the data itself the opportunity to decide upon its most characteristic grouping. The points are in general lower when the air pressure at the base station is rising and higher when the base station pressure is falling, i. e., lower in descending than in ascending air columns. This is true of the points based on summer observations as well as of those based on winter observations. The summer points are, on the average, higher than the winter, but the difference practically all appears in those made over rising air pressure at the earth's surface.

TABLE IX.

	H→L	L→H	Differences.	All ascensions.	Seasonal differences.
April to September:					
Number of observations	7	11	4	18	....
Altitude of S in meters	11826	12731	905	12379	....
Altitude of base station in meters	355	385	30	373	....
Differences	11471	12346	**875**	12006	....
Air pressure at S in millimeters of mercury	160.8	140.5	20.3	148.4	....
Air pressure at base in millimeters of mercury	727.5	725.7	1.8	726.4	....
Differences	566.7	585.2	**18.5**	578.0	....
Temperature at S, °C	−53.6	−53.1	0.5	−53.3	....
Temperature at base, °C	19.9	22.7	2.8	21.6	....
Differences	73.5	75.8	**2.3**	74.9	....
October to March:					
Number of observations	14	12	2	26	8
Altitude of S in meters	10581	12576	1995	11502	877
Altitude of base station in meters	312	287	25	300	73
Differences	10269	12289	**1970**	11202	**804**
Air pressure at S in millimeters of mercury	183.0	142.2	40.8	164.2	15.8
Air pressure at base in millimeters of mercury	734.0	727.2	6.8	730.9	4.5
Differences	551.0	585.0	**34.0**	566.7	**11.3**
Temperature at S, °C	−53.3	−55.6	2.3	−54.4	1.1
Temperature at base, °C	3.4	11.5	8.1	7.1	14.5
Differences	56.7	67.1	**10.4**	61.5	**13.4**
Year:					
Number of observations	21	23	2	44	....
Altitude of S in meters	10996	12650	1654	11861	....
Altitude of base station in meters	326	334	8	330	....
Differences	10670	12316	**1646**	11531	....
Air pressure at S in millimeters of mercury	175.6	141.4	34.2	157.7	....
Air pressure at base in millimeters of mercury	731.8	726.5	5.3	729.0	....
Differences	556.2	585.1	**28.9**	571.3	....
Temperature at S, °C	−53.4	−54.4	1.0	−53.9	....
Temperature at base, °C	8.9	16.8	7.9	13.1	....
Differences	62.3	71.2	**8.9**	67.0	....

Table IX shows the mean height and temperature of S over rising and over falling air pressure for the warmer and for the colder six months of the year. The number of observations used in each mean is also shown. Two of the 46 observations represented in figure 32 were made when high pressure was central at the base station, and are therefore not represented in the means of Table IX. The symbol H→L used in the table means that the base station is in the rear of a low-pressure area or in the front of a high-pressure area, while L→H means that the base station is in the rear of a high-pressure area or in the front of a low-pressure area.

The difference shown in the H→L column of Table IX between the mean altitude of the surface S from April to September and that from October to March is 1202 meters; that in the L→H column is 57 meters or practically none. This fact may be accidental, but probably represents an actual condition in the latitudes considered. It would not be apparent if the observations were grouped into those made over high and those made over low pressure at the earth's surface. Any explanation of seasonal differences in the height of the surface S (this bulletin, Vol. II, p. 16, par. 1) must take account of this fact. It must apply to the heights over rising and not to those over falling air pressure at the earth's surface. Table IX does not show the marked seasonal difference in temperature at the surface S explained by Prof. Humphreys (this bulletin, Vol. II, p. 16, par. 2). It does show a decidedly greater drop in temperature, from the temperature of the lower air strata, in the summer than in the winter months.

If, instead of the grouping used in Table IX, the 46 observations be grouped into (1) those made within areas of high pressure and (2) those made within areas of low pressure, the altitude of the surface S is found to be about the same in both groups—somewhat higher in the low-pressure areas than in the high. It is not easy to see why there should be any difference in the altitude of S in these two groups, and the one found may be attributable to the distribution of the observations. Others have used this grouping in the discussion of their observations and have found the surface S higher in high-pressure areas and lower in low. Having accepted this finding as a universal fact, Prof. Humphreys has offered an explanation for it (this bulletin, Vol. II, p. 16, par. 4). But the fact does not seem to be universal, and the grouping is not a characteristic one when applied to the observations that have been made at Indianapolis, Omaha, and Huron. The differences shown in Table IX are apparently too large to be attributed to the distribution of the observations in the groups there compared.

THE SURFACE OF MINIMUM TEMPERATURE.

The surface of minimum temperature is about 5 kilometers higher up than the surface of maximum change with altitude in vertical temperature gradient, and the number of observations is consequently considerably less. What observations there are seem to show that both surfaces rise and fall with falling and rising air pressure, respectively, at the earth's surface and with the seasons over rising air pressure. They seem to be farther apart in the summer than in the winter months. The temperature changes from day to day at the surface of minimum temperature are apparently much greater than those at the surface of greatest change with altitude in the vertical temperature gradient.

The temperature minima in the surface of minimum temperature seem to travel from west to east across the country. (See figs. 5 and 6.) The temperature minimum observed at Omaha on October 5 seems to have been observed at Indianapolis on October 6. When observed at a given place (see figs. 5, 6, 13, and 16) these temperature minima appear aperiodically 2 or 3 to 5 or 6 days apart. Any of these figures may therefore be looked at either as showing the changes in the temperature at all levels with time or as showing an approximately east to west cross section of the atmosphere as far up as the observations go. The greatest changes of temperature noted from one observation to the next, all levels considered, take place at the surface of minimum temperature. In general, the more sharply defined temperature minima in the surface of minimum temperature, usually those minima that also have the lower temperatures, are found over falling air pressure at the earth's surface, while the less sharply defined minima are found over rising air pressure at the earth's surface. The summer temperatures in the surface of minimum temperature seem to be lower than those of winter.

THE UPPER OR PERMANENT INVERSION OF TEMPERATURE.

The surface of minimum temperature seems to mark the base of a well-defined inversion of temperature. According to figure 31 and Table VI (last column), this inversion of temperature extends from about the 15.5 to the 28 kilometer level and has an average increase in temperature with altitude of 1.5° C. per kilometer. There is but one observation at the 27 to 30 kilometer levels, but it shows a slight decrease in temperature with altitude above the 28-kilometer level. The temperature shown in Table VI (last column) at the base of the upper or permanent inversion is −55.2° C., at its upper limit −37.9° C.

It does not appear from these data that the term "isothermal layer" or "isothermal region" can be applied to that part of the earth's atmosphere lying above the surface of greatest change with altitude in the vertical temperature gradient. Neither can it be applied above the surface of minimum temperature nor the probable surface of maximum temperature next above it. At the point of application of the results of his discussion (The Isothermal Layer of the Atmosphere and Atmospheric Radiation, Proc. Roy. Soc. of London, A 82, p. 43) Mr. Gold assumes the earth's atmosphere to "consist of two shells, the inner in the adiabatic, the outer in the isothermal state." This assumption is an approximation to the actual conditions which, according to the data here summarized, does not take account of the drop in temperature of 7.2° C. between the first and second surfaces mentioned above, the rise of 17.3° C. between the second and third, and the marked decrease in temperature with altitude above the last level.

DISCUSSION OF FACTS SHOWN BY ABOVE SUMMARY.

Since free balloons have been used to carry meteorological instruments to great heights, many opinions have been expressed as to the cause of the changes shown by observed temperatures with altitude and with meteorological conditions at the earth's surface. These opinions are in fairly good agreement so far as temperature peculiarities of the lower strata are concerned, but vary widely as to the reason for the temperatures found at the higher levels. This is to be expected, since at these levels there are comparatively few, not very well distributed observations.

In the above summary a number of assumptions used and conclusions arrived at by others have been called in question because they are not in accord with the conclusions pointed out by the data here summarized. In general, these assumptions and conclusions are those introducing anything in the nature of discontinuity in the composition or condition of the atmosphere and consequent sharply defined boundary planes separating strata having, presumably, widely different properties—e. g., see this bulletin, Volume II, page 3, last paragraph. Nothing approximating such discontinuity is apparent from the data.

In the more recent discussions of the vertical temperature gradient of the atmosphere by Gold and by Humphreys the absorption and radiation of heat by the atmosphere itself has the important place. Both of these papers have been referred to above in connection with the facts shown by the data there summarized; the latter more frequently than the former because Prof. Humphreys makes very specific application of his theory to supposedly established facts, while Mr. Gold deals conservatively with the available meteorological data and applies the results of his discussion in a very general way only.

It is to be expected that as observations with improved apparatus increase and are extended to other elements than those now observed, earlier opinions (including those expressed in the following discussion) may be modified more or less.

CONVECTION.

While the absorption and radiation of heat by the atmosphere play a very important part in the determination of its vertical temperature gradient, it is the opinion of the writer that convection and attendant phenomena must be carefully taken into account, especially in the explanation of the differences in the character of the vertical temperature gradient shown by successive observations not far apart in point of time, by simultaneous observations at points no great horizontal distance apart, and by observations above similar meteorological conditions at the earth's surface.

As far up as explorations extend the air seems to descend over rising and to ascend over falling air pressure at the earth's surface. Above the surface of greatest change with altitude in the vertical temperature gradient, the adiabatic heating in the descending air column and the adiabatic cooling in the ascending air column probably exceed the normal vertical temperature gradient; below this surface, they are probably less than the normal vertical temperature gradient. That the temperatures are higher than normal above the surface mentioned and lower below it in the descending air column—higher below the surface mentioned and lower above it in the ascending air column—may be accounted for in this way. That the surface itself has a seasonal variation in altitude in the descending air column may be owing, primarily, to different rates and amounts of descent in different seasons and to the local convection currents next mentioned. It is also probable that the constitution of the air in the descending current differs slightly from that in the ascending current, and in such a way that the wave lengths absorbed and radiated by the airs of the two currents give rise to differences in the relative importance of solar and terrestrial radiations in the determination of their air temperatures.

The general ascent and descent of the air over falling and rising air pressure at the earth's surface is apparently to be considered apart from the more local convection currents. The latter have their origin at the earth's surface and at cloud levels. They are especially characteristic of the region over falling air pressure at the earth's surface in all seasons, but are of frequent occurrence over rising air pressure at the earth's surface in the summer months.

Condensation takes place in these currents in two fairly well-defined levels. The limits of these condensation layers are shown in the vertical temperature gradient. There is a marked decrease in the value of this gradient with altitude at the base of each layer. Figure 31 shows the effect on the mean vertical temperature gradient. According to this mean the lower layer begins at about 1.2 kilometers and extends to about 5. The upper layer begins at about 9 kilometers and probably extends to the surface of minimum temperature. There is some evidence, in the vertical temperature gradient of the summer months and also in observations of cloud altitudes, of a third, or possibly of a comparatively deep upper, region of condensation. What little condensation has been observed in this region has been in the summer months. Its upper limit is probably coincident with the second minimum of temperature mentioned above as characteristic of the summer vertical temperature gradient.

The air temperature and altitude of the lower limit of the lower condensation layer vary with the relative humidity and with the presence of nuclei. They may therefore be expected to have diurnal, seasonal, and local variations. The phenomena of this layer bear a close relationship to those meteorological phenomena observed at the earth's surface.

There seems to be little, if any, seasonal variation in these latitudes in the temperature or height at which condensation begins in the upper of the two well-defined condensation layers, although, as noted above, these values vary considerably from time to time and from place to place in the same season and over similar meteorological conditions at the earth's surface. They are apparently not dependent on the relative humidity so much as on some element or elements, possibly carbon dioxide and ammonia, proportions of which in the lower atmosphere do not have so great a seasonal variation. Those differences in the height and temperature not related to seasonal or surface meteorological conditions may be directly related to the nature of the local convection which obtains at the time and place of observation.

In the discussions of adiabatic cooling and heating in the atmosphere, vertical components of air currents usually get most consideration. It is to be noted in this connection that, in horizontal currents of the velocities that obtain in the region of the upper condensation layer, adiabatic cooling may be of nearly the same order as that found in the ascending currents of average velocity. The adiabatic cooling effects of both the vertical and horizontal components of these upper-air currents, together with the following consideration of nucleation at these levels, may account for many, if not all, the cloud forms observed in the upper condensation layer.

NUCLEATION.

It is probable that the nuclei in the lower condensation layer are dust particles carried from the earth's surface by the ascending air currents. (This bulletin, Vol. III, p. 169.) The part played by ions, either negative or positive, as nuclei for the condensation of water vapor is a doubtful one. The observations by Simpson and others on the charges brought down by rain, together with the fact that a high degree of supersaturation is needed in an air mass before condensation will take place on its ions, point to the conclusion that ordinarily no considerable direct use is made of ions as nuclei in either the lower or the upper condensation layers. Dust particles are probably present in sufficient quantity in the lower layer, but possibly not in the upper.

The relative humidities observed above the lower condensation layer seldom exceed 50 or 60 per cent. It is therefore not easily seen how the ice spicules of the cirrus clouds come into existence unless they form as frost on some cold particle which acts as a nucleus. An experiment was undertaken to see whether the vapors of carbon dioxide or ammonia would, under the conditions of temperature and pressure found at the upper condensation layer, furnish the cold nuclei for the formation of ice spicules. The exceedingly small proportions of carbon dioxide and ammonia vapors present in the air was not considered a serious objection to the investigation, because the latent heat of condensation of the water vapor might be counted on to dissolve the nucleus upon which it condensed, leaving the vapor forming the nucleus free to renucleate, at a higher level presumably, and the ice spicule to grow and probably break up forming other nuclei. A condition of saturation of the vapors of carbon dioxide and ammonia may or may not be necessary in order that aggregations of molecules sufficient to act as nuclei should take place at the low temperatures and pressures of the upper condensation layer. The presence of dust and of ions may be of assistance in this molecular aggregation.

A small cylindrical fog chamber was constructed 36 centimeters long and 10 centimeters in diameter. This chamber was so jacketed that its temperature could be lowered and maintained at a desired point. The chamber was connected to the large calibrating chamber before described in such a way that transfer of heat to the fog chamber could not take place by convection. Gas could be admitted to the fog chamber through a brass tube of 1 centimeter diameter, 50 centimeters of which was at the same temperature as the inside of the chamber. At its connection with the chamber the opening was 2.4 millimeters in diameter. The ends of the fog chamber were of clear mica—two parallel sheets about 3 millimeters apart were at each end. The inner of the two sheets was pierced, the opening being less than 1 millimeter in diameter.

The air was pumped from this system down to 50 or 75 millimeters pressure and air dried by having bubbled through sulphuric acid and passed through a calcium chloride drier was admitted. The operation was repeated several times. Then carbon dioxide from a tube which had been filled with liquid carbon dioxide, but in which only the vapor remained, was admitted through the same drying system and pumped out. The temperature of the fog chamber was then lowered to −61° C. and the pressure to 84 millimeters of mercury. A rubber tube clamp was opened momentarily and a cloud appeared in the fog chamber. The fog disappeared quickly, and no change in temperature was shown by the toluol thermometer used. At the time the next puff of carbon dioxide was admitted, the temperature and pressure inside the chamber were −62° C. and 98 millimeters, respectively. The fog appeared as before. Air admitted in the same way when the temperature in the chamber was −62° C. and at pressures of 92 and of 94 millimeters produced no visible cloud. Moist air admitted from the room had to pass through the 50 centimeters of cooled brass tubing for a considerable time before enough moisture to form a visible cloud had entered. The pressure and temperature of the gas before being admitted to the chamber were in every case approximately 722.5 millimeters and 24° C., respectively. In the process of showing the cloud, produced by the admission of carbon dioxide, to several observers the apparatus broke down. The above experimental observations were made July 11, 1910.

More recent experiment shows that, after having passed through a drying system similar to the one described above and being brought back to a temperature of 15° C., the relative humidities of air and carbon dioxide, as computed from readings of wet and dry bulb thermometers, were 4 per cent and 6 per cent, respectively. It is probable that, if these humidities had been measured at a lower temperature, there would have been better agreement between them. Later experiments will determine this.

Water seems to be in close combination with the carbon dioxide of the atmosphere whatever the atmospheric temperature. The capacity of carbon dioxide for the water of this combination seems to increase as the temperature of the carbon dioxide decreases, between limits not yet determined. The water of this combination seems not to affect the reading of a wet and dry bulb psychrometer, and probably does not affect the reading of a hair hygrometer. It seems impossible to remove the water of this combination by the use of sulphuric acid and the deliquescent salts usually used in drying gases.

It appears highly probable that the slowly moving aggregations of molecules which must result from this carbon dioxide-water combination may, in currents of expanding air, furnish not only the cold nuclei for the formation of the ice spicules of the upper condensation layer, but also some of the moisture of which the ice spicules are formed.

The above experimental observations are hardly conclusive and would not be reported at this time were it not that the free air data are now ready for publication. Further experimental results will be reported later.

ABSORPTION AND RADIATION.

Assuming an average distribution of the constituent gases, vapors, and dust of the earth's atmosphere to be at rest for a time, and considering the vertical temperature gradient that would obtain under the influence of absorption and radiation and of conduction of heat, it should be possible to arrive at a fairly definite result for a given season and locality. Such a computation would need to be based on the distribution of the constituent gases and vapors of the atmosphere and on what is known about the absorption and radiation of heat by these constituents. It would also take into account the radiators on either side of the atmosphere, between which the latter assumes a temperature distribution definitely related to the former.

Experimental evidence is needed of the distribution of the vapors of water, carbon dioxide, and ammonia (possibly others) in the lower strata, since in this region the distribution of these vapors is more or less influenced by their condensation in convection currents. For the distribution of these constituents in the upper strata and for the distribution of the more permanent gases of the atmosphere formulae have been developed by Jeans (The Dynamical Theory of Gases, p. 315) and by others. The amount of ozone present in the atmosphere needs experimental determination; also the dust content of the lower strata, possibly of the higher.

Much experimental work has been done on the intensity of solar radiation, on the reflection of this radiation by cloud and other surfaces in the atmosphere and by the earth's surface, and on the absorption and radiation of heat by the constituents of the atmosphere. A summary of this work, the latter in so far as it relates to water vapor, carbon dioxide, ozone, and the air as constituted at the earth's surface, is given by Mr. Gold in the paper referred to above.

The temperatures found would vary with the varying proportions in which the constituent gases and vapors of the atmosphere were present, and would therefore, in general, decrease with altitude, approaching at the very high levels the temperature of an atmosphere of hydrogen or of some lighter gas. (A. Wegener, Physikalische Zeitschrift, March, 1911, p. 170.)

It seems plausible that in such a computation the constituent, water vapor, will remain an important factor even at very high levels. Its molecular weight is next in order above that of helium, so that, while always forming a small proportion of the whole atmosphere, its amount may be considerable even when compared with that of the nitrogen present at the same level. Chiefly because of variations in the amount and form of the water present in the atmosphere, the character of this computed vertical temperature gradient would not be the same for different seasons in a given locality nor for different localities in a given season. The changes in this gradient with altitude would not be uniform until some level well above the upper condensation layer had been reached. The decrease in temperature with altitude will be smaller below and larger above a surface of maximum proportion of water vapor, larger below and smaller above a surface of minimum proportion of water vapor. This relation will be modified by the presence of other constituents. Some of these constituents may be especially abundant in the dryer, others in the moister regions.

The temperatures themselves will not be far from the observed normal temperatures even in the region in which convection obtains, since the general effect of convection on the distribution of the constituent gases and vapors of the atmosphere has been taken into account in their determination.

The decrease of temperature with altitude above the upper maximum of temperature explored probably extends to very high levels This may account, in part at least, for the lack of agreement between the conclusions of Prof. C. C. Trowbridge, drawn from his experiments in gas phosphorescence, and the computed air pressures by Prof. J. H. Jeans at 80 to 100 kilometers up. The computations by Prof. Jeans were made on the assumption of a uniform temperature of —53° C. throughout the upper atmosphere. (This bulletin, Vol. II, p. 351.)

The temperatures of the lower strata observed above a place at a given time will usually differ from the above-computed temperatures. So far as the atmosphere is concerned, these differences may be accounted for by the prevailing convection. The latter will modify the computed temperatures in several ways, important among which are the following:

(1) By its effect on the distribution of the constituent vapors and gases of the atmosphere.

(2) By the adiabatic heating and adiabatic cooling of the air which takes place in convection. Taking a large enough territory and a suitable period of time, the adiabatic heating and cooling should balance each other, although locally and in point of time there are regions in which ascending currents prevail and others in which descending currents prevail.

(3) By the presence and distribution of dust carried into the air by convection currents.

(4) By the transfer from place to place of warm and of cold masses of air.

(5) By the condensation which takes place in convection currents. The effect of the latent heat of evaporation of moisture will balance that of an equal amount of latent heat liberated in the condensation of moisture, and only the latent heat liberated in the condensation of

moisture which is precipitated will be effective in modifying the mean air temperature, a large enough area and a sufficient time considered. The latent heat liberated in the condensation of precipitation would, if convection were absent, not so much be lost to the atmosphere as differently distributed in it. A cloud-air surface probably reflects 65 per cent of the incident solar radiation. (Annals, Astrophysical Observatory, Smithsonian Institution, Vol. II, p. 144.) The effect of this in reducing the total amount of solar energy absorbed by the earth and its atmosphere would be taken into account in the above-computed temperatures, but it is an effect local in character and needs mention in this connection. On the other hand, the whole amount of terrestrial radiation absorbed by the atmosphere is not much affected by the presence of clouds. The absorption of both solar and terrestrial radiation will, however, be more or less localized by them.

It follows that the effect of convection on air temperature is largely one of distribution. It is an important factor when the air temperatures of the lower atmosphere peculiar to a given time, place, or level are considered; and, upon the general distribution of the constituent gases, vapors, and dust of the atmosphere in and peculiar to the convective region, seems to depend the general character of the vertical temperature gradient as far up as it has been observed. A distribution of these constituents, such as might be expected in the absence of convection would, under the influence of the radiators on either side of the atmosphere, be accompanied by a smooth, gradually decreasing vertical temperature gradient, the actual temperatures varying with the variations of the outside radiators. Above the region in which condensation takes place the effects of convection on the mean temperatures as well as the convection itself will be much reduced and the actual temperatures should agree closely with those which might be computed on the assumption made at the beginning of this part of the discussion. The agreement will be closer at the higher levels.

THE VERTICAL GRADIENT IN DIFFERENT LATITUDES.

The above discussion has been confined chiefly to conclusions pointed out by the data above summarized. Convection attending the passing of high and low pressure areas across the country and that of a more local nature only have been considered. The temperature and other data necessary to the extension of this discussion to include the effects of the convection accompanying the more permanent high and low pressure areas is not yet very plentiful or very well distributed. There are, however, one or two indications in the above data that may be mentioned in this connection.

The data above summarized, taken together with cloud observations, give evidence of a third or comparatively deep upper condensation layer in the summer season, and of lower minimum temperatures at higher altitudes in the summer than in the winter months. In the longer, warmer summers of lower latitudes this effect is probably more pronounced. A shifting to a higher level of the surface in which the maximum condensation of the upper condensation layer takes place may be expected as the region of maximum insolation is approached. This is equivalent to saying that in the regions of greater insolation, in point of location as well as of time, the atmosphere is stirred to a greater height by convection currents.

If it be true that condensation in the upper condensation layer is to some extent forced by the presence of cold nuclei, the increase in height of the surface in which maximum condensation takes place would increase the height of the accompanying surface of minimum proportion of water vapor and consequently the surface of minimum temperature. The more energetic convection accompanying the greater insolation may force condensation further, leaving a smaller proportion of water vapor in the air at the surface of minimum proportion referred to above. This would mean a lower minimum temperature.

So far as they go, these observations indicate conditions in the larger convection units similar to those found in the smaller and support the conclusion that, in general, the peculiarities in the temperature gradient up to and including the upper or permanent inversion owe their existence to the influence of convection on the distribution of the constituents, especially of the water, of the atmosphere.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911).*

FIRST SERIES, OMAHA.

SEPTEMBER 25, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. h. m.	m.	mm.	° C.		Per cent.		m. p. s.	
3 10	312	742.4	22.0	....	....	S. 50° E.	5.6	Cloudless.
....	500	....	19.4	....	....	S. 50° E.	5.6	
....	1000	....	12.2	....	....	S. 50° E.	5.6	
3 14	1148	672.6	10.0	1.4	....	S. 50° E.	5.6	
....	1500	....	8.2	....	....	S. 39° W.	2.6	
3 18	1758	624.6	7.0	0.5	....	S. 39° W.	1.0	Clock stopped; subsequent altitudes computed from ascensional rate.
....	2000	....	....	....	....	N. 5° W.	1.5	
3 20	2122	....	....	....	....	N. 5° W.	1.7	
....	2500	....	....	....	....	N. 52° W.	2.5	
3 25	3027	....	....	....	....	N. 52° W.	3.5	
....	3500	....	....	....	....	N. 27° W.	5.3	
3 30	3932	....	....	....	....	N. 27° W.	6.7	
....	4000	....	....	....	....	N. 26° W.	6.7	
....	4500	....	....	....	....	N. 21° W.	6.6	
3 35	4837	....	....	....	....	N. 19° W.	6.5	
....	5000	....	....	....	....	N. 13° W.	5.9	
....	5500	....	....	....	....	N. 5° E.	4.4	
3 40	5742	....	....	....	....	N. 7° E.	3.8	
....	6000	....	....	....	....	N. 16° E.	5.8	
....	6500	....	....	....	....	N. 32° E.	9.1	
3 45	6647	....	....	....	....	N. 35° E.	9.8	
....	7000	....	....	....	....	N. 43° E.	11.7	
3 50	7552	....	....	....	....	N. 48° E.	14.0	
....	8000	....	....	....	....	N. 45° E.	13.7	
3 55	8457	....	....	....	....	N. 45° E.	12.8	
....	8500	....	....	....	....	N. 45° E.	12.8	
....	9000	....	....	....	....	N. 30° E.	13.0	
4 00	9362	....	....	....	....	N. 16° E.	13.3	
....	9500	....	....	....	....	N. 10° W.	13.0	
4 03	9905	....	−56.8	....	....	N. 23° W.	11.9	Balloon burst.

SEPTEMBER 27, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind direction.	Wind velocity.	Remarks.
2 58	312	741.6	19.6	....	44	S. 27° W.	3.8	
....	500	....	18.0	....	43	S. 27° W.	3.8	
....	1000	....	13.6	....	40	S. 27° W.	3.8	Cloudless.
3 04	1176	669.6	12.2	0.8	39	S. 27° W.	3.8	Inversion.
3 05	1387	652.9	13.0	−0.4	34	S. 61° W.	4.1	
....	1500	....	11.7	....	36	N. 41° E.	4.0	
3 12	1912	612.7	6.6	1.2	45	N. 41° E.	3.5	
....	2000	....	6.6	....	44	N. 69° W.	3.4	
....	2500	....	6.4	....	36	N. 69° W.	3.1	
3 14	2827	547.9	6.3	0.0	32	N. 69° W.	2.9	
....	3000	....	5.5	....	29	N. 60° W.	3.3	
....	3500	....	3.2	....	23	N. 40° W.	4.2	
3 20	3717	491.0	2.1	0.5	20	N. 30° W.	4.6	
....	4000	....	0.4	....	18	N. 22° W.	5.8	
....	4500	....	− 2.7	....	14	N. 10° W.	8.0	
3 27	4816	427.6	− 4.6	0.6	12	N. 2° W.	9.3	
....	5000	....	− 5.9	....	....	N.	10.1	
....	6000	....	−13.3	....	....	N. 10° E.	14.0	
3 36	6257	354.6	−14.9	0.7	....	N. 12° E.	15.0	
....	7000	....	−22.3	....	....	N. 17° E.	16.2	
3 44	7554	297.3	−27.8	1.0	....	N. 21° E.	17.0	
....	8000	....	−32.3	....	....	N. 22° E.	17.6	
3 50	8639	254.7	−38.6	1.0	....	N. 25° E.	18.6	Balloon disappeared.
....	9000	....	−41.8	....	....	....	....	
3 55	9803	214.1	−48.8	0.9	....	....	....	
3 56	10075	205.4	−49.2	0.1	....	....	....	
4 01	11010	177.7	−55.2	0.6	....	....	....	
....	12000	....	−62.7	....	....	....	....	Pressure pen not recording.
4 08	12062	....	−63.2	0.7	....	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

SEPTEMBER 28, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 30	312	734.2	28.2	....	33	S. 83° W.	6.8	
....	500	....	26.5	....	32	S. 83° W.	6.8	Cloudless.
3 35	934	683.7	22.0	1.0	29	S. 83° W.	6.8	
....	1000	....	21.4	....	....	S. 86° W.	7.3	
....	1500	....	17.2	....	....	N. 83° W.	10.7	
3 39	1926	608.4	13.6	0.8	....	N. 73° W.	13.6	
....	2000	....	13.6	....	....	N. 51° W.	13.7	
3 40	2079	597.4	13.5	0.0	....	N. 29° W.	13.7	
....	2500	....	10.3	....	....	N. 25° W.	13.2	
3 45	2743	551.5	8.4	0.8	46	N. 23° W.	12.9	
....	3000	....	6.3	....	52	N. 20° W.	13.4	
....	3500	....	2.3	....	55	N. 16° W.	14.4	
3 50	3615	495.4	1.4	0.8	57	N. 14° W.	14.9	
....	4000	....	− 1.7	....	61	N. 13° W.	14.4	
....	4374	450.2	− 4.8	0.8	65	N. 13° W.	13.9	
3 54	4500	....	− 4.7	....	63	N. 15° W.	12.2	Inversion.
3 55	4568	439.2	− 4.6	−0.1	62	N. 17° W.	11.7	
....	5000	....	− 7.5	....	57	N. 13° W.	10.2	
4 01	5454	391.8	−10.8	0.7	53	N. 10° W.	8.6	
....	6000	....	−14.8	....	53	N. 18° W.	10.2	
4 07	6487	341.8	−18.4	0.7	53	N. 22° W.	11.6	
....	7000	....	−22.0	....	59	N. 21° W.	15.0	
4 13	7705	289.4	−27.0	0.7	67	N. 19° W.	19.5	
....	8000	....	−29.5	....	60	N. 22° W.	19.8	
4 18	8579	255.8	−34.4	0.9	48	N. 28° W.	20.4	
....	9000	....	−36.8	....	47	N. 25° W.	22.2	
4 24	9851	212.6	−41.6	0.6	46	N. 19° W.	25.3	
....	10000	....	−42.3	....	46	N. 19° W.	27.4	
....	11000	....	−46.9	....	46	N. 18° W.	32.5	
4 28	11106	176.2	−47.4	0.5	46	N. 18° W.	33.8	
....	12000	....	−49.3	....	46	N. 14° W.	30.0	
....	13000	....	−51.5	....	46	N. 9° W.	25.5	
4 35	13280	126.3	−52.1	0.2	46	N. 8° W.	24.4	
....	14000	....	−53.6	....	46	N. 10° W.	18.0	
4 38	14106	111.1	−53.8	0.2	46	N. 11° W.	16.7	
4 42	14983	96.9	−53.9	0.0	47	N. 8° W.	10.0	Inversion.
....	15000	....	−53.8	....	47	N. 9° W.	9.9	
4 43	15776	85.8	−52.3	−0.2	47	N. 13° W.	9.6	
....	16000	....	−51.9	....	47	N. 12° W.	9.6	
4 48	16952	71.1	−50.0	−0.2	46	N. 10° W.	9.6	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

SEPTEMBER 30, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
2 59	312	735.8	21.5	....	54	S. 36° E.	2.2	
....	500	....	19.7	....	....	S. 36° E.	2.2	
....	1000	....	15.5	....	....	S. 36° E.	2.2	Cloudless.
3 04	1028	676.6	15.2	0.9	....	S. 36° E.	2.2	
3 06	1454	643.2	14.3	0.2	....	S. 75° E.	2.2	Isothermal.
3 08	1832	615.0	14.3	0.0	....	N. 30° W.	4.2	
....	2000	....	12.8	....	....	N. 27° W.	4.8	
3 11	2399	574.5	9.0	0.9	....	N. 21° W.	6.0	
3 12	2534	565.2	8.7	0.2	....	N. 11° W.	6.0	
....	3000	....	3.5	....	....	N. 16° W.	5.8	
....	3500	....	− 1.8	....	....	N. 21° W.	5.5	
....	4000	....	− 7.3	....	....	N. 27° W.	5.3	
3 21	4159	461.2	− 9.1	1.1	....	N. 29° W.	5.2	
....	4500	....	−11.4	....	....	N. 32° W.	4.8	
....	5000	....	−14.6	....	....	N. 38° W.	4.1	
3 28	5139	405.6	−15.5	0.7	....	N. 39° W.	4.0	
3 32	5842	369.0	−23.9	1.2	....	N. 45° W.	7.5	
....	6000	....	−25.3	....	....	N. 45° W.	7.7	
....	7000	....	−33.9	....	....	N. 45° W.	8.5	
3 41	7370	297.6	−37.2	0.9	....	N. 45° W.	8.8	
....	8000	....	−43.8	....	....	N. 47° W.	9.1	
3 49	8762	241.9	−50.7	1.0	....	N. 49° W.	9.7	
....	9000	....	−52.8	....	....	N. 52° W.	9.8	
3 52	9283	....	−55.2	0.9	....	N. 57° W.	9.9	
3 54	9677	....	−56.2	0.2	....	N. 83° W.	13.4	
....	10000	....	−57.7	....	....	N. 80° W.	13.3	
4 00	10700	....	−60.9	0.5	....	N. 73° W.	13.1	
....	11000	....	−62.1	....	....	N. 74° W.	12.3	
4 06	11812	....	−65.2	0.4	....	N. 78° W.	10.2	

OCTOBER 4, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
3 38	312	737.5	26.2	....	53	S. 64° E.	1.7	Few Ci.-St. NW.
....	500	....	24.4	....	....	S. 64° E.	1.7	
3 42	824	695.3	21.5	0.9	....	S. 64° E.	1.7	Isothermal.
3 43	979	682.9	21.5	0.0	....	S. 19° W.	3.2	
....	1000	....	21.3	....	....	S. 19° W.	3.2	
....	1500	....	15.6	....	....	S. 19° W.	3.2	
3 47	1637	632.1	14.2	1.1	....	S. 19° W.	3.2	
....	2000	....	9.3	....	....	S. 16° W.	3.7	
3 51	2235	588.1	6.1	1.4	....	S. 15° W.	4.0	
....	2500	....	4.0	....	....	S. 14° W.	3.7	
3 55	2924	540.1	0.7	0.8	....	S. 12° W.	3.4	Clock stopped.
....	10273	195.5	−52.6	0.7	....	....	....	Clock started.
....	11000	....	−54.5	....	....	....	....	
....	12000	....	−57.2	....	....	....	....	
....	12489	139.1	−58.8	0.3	....	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

OCTOBER 5, 1909.

Time.	Altitude.	Pressure.	Temperature.	Δt / 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 03	312	738.6	27.6	....	46	S. 42° E.	4.7	
....	500	....	26.0	....	....	S. 42° E.	4.7	Cloudless.
3 06	789	699.4	23.5	0.9	....	S. 42° E.	4.7	
3 07	886	691.6	22.8	0.7	....	S. 2° W.	4.3	
....	1000	....	21.9	....	....	S. 4° W.	4.6	
....	1500	....	17.7	....	....	S. 15° W.	6.2	
3 12	1894	614.6	14.6	0.8	....	S. 23° W.	7.5	
....	2000	....	13.3	....	....	S. 23° W.	7.5	
....	2500	....	7.5	....	....	S. 23° W.	7.4	
3 17	2777	552.3	4.1	1.2	....	S. 23° W.	7.4	
....	3000	....	3.8	....	....	S. 23° W.	7.5	
3 18	3029	535.4	3.7	0.2	....	S. 23° W.	7.5	
....	3500	....	− 0.4	....	....	S. 25° W.	5.9	
....	4000	....	− 4.9	....	....	S. 28° W.	4.3	
3 26	4452	447.3	− 8.9	0.9	....	S. 30° W.	3.0	Isothermal.
3 27	4612	438.1	− 8.9	0.0	....	S. 36° W.	3.5	
....	5000	....	−12.5	....	....	S. 36° W.	3.5	
....	6000	....	−21.7	....	....	S. 36° W.	3.6	
3 35	6170	356.1	−23.3	0.9	....	S. 36° W.	3.6	
3 36	6238	352.8	−23.5	0.3	....	S. 10° W.	3.5	
....	7000	....	−30.3	....	....	S. 10° W.	3.5	
3 42	7476	296.7	−34.6	0.9	....	S. 10° W.	3.5	
....	8000	....	−38.8	....	....	W.	2.4	
3 50	8913	....	−46.7	0.8	....	W.	0.4	
....	9000	....	−47.6	....	....	N. 54° W.	0.7	
....	10000	....	−57.5	....	....	N. 54° W.	3.7	
3 56	10011	....	−57.6	1.0	....	N. 54° W.	3.7	
....	11000	....	−61.3	....	....	N. 59° W.	5.6	
4 05	11658	....	−63.8	0.4	....	N. 62° W.	6.9	Inversion.
....	12000	....	−63.3	....	....	N. 65° W.	6.7	
4 11	12756	....	−62.1	−0.2	....	N. 71° W.	6.1	
4 12	12939	....	−62.9	0.5	....	N. 37° W.	5.8	
....	13000	....	−62.7	....	....	N. 37° W.	5.6	
....	14000	....	−58.9	....	....	N. 37° W.	3.4	
4 19	14286	....	−57.8	−0.4	....	N. 37° W.	2.7	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

OCTOBER 6, 1909.

Time.	Altitude.	Pressure.	Temperature.	Δt / 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 58	312	734.2	28.5	....	27	S. 5° W.	13.4	
....	500	....	27.3	....	....	S. 5° W.	13.4	
....	1000	....	24.2	....	....	S. 5° W.	13.4	Cloudless.
4 02	1440	645.2	21.4	0.6	....	S. 5° W.	13.4	
....	1500	....	20.9	....	....	S. 7° W.	13.0	
....	2000	....	15.8	....	....	S. 10° W.	12.6	
....	2500	....	10.7	....	....	S. 14° W.	12.2	
4 07	2692	556.1	8.6	1.0	....	S. 16° W.	11.7	Inversion.
....	3000	....	9.3	....	....	S. 50° W.	12.8	
4 08	3060	531.9	9.4	−0.2	....	S. 56° W.	13.2	
....	3500	....	6.2	....	....	S. 60° W.	13.7	
4 11	3911	479.3	2.8	0.8	....	S. 64° W.	14.2	
....	4000	....	2.4	....	....	S. 66° W.	13.2	
....	4500	....	− 2.5	....	....	S. 70° W.	12.2	
....	5000	....	− 7.2	....	....	S. 75° W.	11.2	
4 15	5090	411.9	− 7.9	0.8	....	S. 77° W.	10.2	One balloon burst.
[1] 4 42	365	729.5	26.7	....	....	....	....	
....	500	....	26.1	....	....	....	....	
....	1000	....	22.7	....	....	....	....	
4 58	1186	663.7	21.4	0.6	....	....	....	
....	1500	....	18.6	....	....	....	....	
....	2000	....	13.8	....	....	....	....	
....	2500	....	9.3	....	....	....	....	
5 23	2535	565.5	9.0	0.9	....	....	....	Inversion.
5 26	2812	546.9	10.1	−0.4	....	....	....	
....	3000	....	8.8	....	....	....	....	
5 37	3499	503.0	5.4	0.7	....	....	....	
....	4000	....	0.3	....	....	....	....	
....	4500	....	− 4.6	....	....	....	....	
5 55	4656	435.0	− 6.2	1.0	....	....	....	
....	5000	....	− 9.4	....	....	....	....	
6 13	5738	377.7	−16.4	0.9	....	....	....	
....	6000	....	−18.3	....	....	....	....	
6 28	6777	328.2	−24.6	0.8	....	....	....	Clock stopped.
....	15984	82.5	....	....	....	....	....	
....	....	....	−68.6	....	....	....	....	

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[1] Second ascension: After the balloons had landed the burst balloon evidently became detached; the remaining balloon again ascended.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

OCTOBER 7, 1909.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
3 09	312	728.6	27.8	....	33	S. 6° E.	15.8	
....	500	....	26.5	....	34	S. 6° E.	15.8	
....	1000	....	23.0	....	37	S. 4° E.	15.8	
3 12	1253	654.7	21.2	0.7	38	S. 4° E.	15.8	9/10 A.-St. SSW.
....	1500	....	18.6	....	41	S. 2° E.	17.2	
....	2000	....	13.3	....	50	S.	19.9	
3 15	2401	571.4	9.0	1.1	54	S. 2° W.	22.1	
....	2500	....	8.1	....	55	S. 3° W.	22.0	
....	3000	....	3.7	....	59	S. 8° W.	22.0	
3 18	3213	517.5	1.8	0.9	61	S. 9° W.	21.9	Inversion.
3 19	3485	500.6	2.2	0.0	53	S. 14° W.	26.3	
....	3500	....	2.1	....	53	S. 14° W.	26.3	
....	4000	....	− 1.2	....	55	S. 14° W.	26.3	
3 22	4312	452.7	− 3.1	0.6	57	S. 14° W.	26.3	
....	4500	....	− 4.8	....	56	S. 14° W.	25.2	
....	5000	....	− 8.7	....	54	S. 13° W.	22.5	
3 27	5595	383.4	−14.1	0.9	52	S. 12° W.	19.2	Balloon in clouds.
3 28	5847	371.1	−13.6	0.0	54	....	....	Inversion.
....	6000	....	−14.5	....	54	....	....	
3 31	6849	326.4	−19.9	0.6	54	....	....	
....	7000	....	−21.1	....	54	....	....	
3 36	7801	286.3	−27.6	0.8	53	....	....	
....	8000	....	−29.2	....	53	....	....	
3 40	8825	247.8	−35.9	0.8	52	....	....	
....	9000	....	−37.3	....	52	....	....	
3 44	9742	216.9	−43.4	0.8	52	....	....	
....	10000	....	−45.5	....	52	....	....	
3 48	10778	186.1	−51.2	0.8	52	....	....	
....	11000	....	−52.7	....	52	....	....	
3 51	11547	166.0	−56.0	0.6	52	....	....	Inversion.
....	12000	....	−55.9	....	52	....	....	
3 56	12699	139.8	−55.6	0.0	52	....	....	
....	13000	....	−54.8	....	51	....	....	
4 00	13533	122.9	−53.2	−0.3	50	....	....	
....	14000	....	−53.1	....	49	....	....	
4 05	14989	98.2	−52.9	0.0	48	....	....	

OCTOBER 9, 1909.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Direction.	Velocity.	Remarks.
3 17	312	731.9	9.8	....	84	NW.	5.4	
....	500	....	8.1	....	89	NW.	....	10/10 St. NW.
3 19	884	682.9	5.0	0.8	100	NW.	....	Balloon in clouds.
....	1000	....	5.1	....	100	NW.	....	
3 20	1254	653.5	5.1	−0.1	100	NW.	....	Inversion.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

OCTOBER 10, 1909.

Time.	Altitude.	Pressure.	Temperature	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
2 59	312	729.7	10.4	....	80	N. 23° W.	17.9	
....	500	....	9.1	....	75	N. 23° W.	17.9	7/10 St. NNW.
....	1000	....	5.2	....	62	N. 23° W.	17.9	Lt. rain.
3 03	1408	638.2	2.4	0.7	51	N. 23° W.	17.9	
....	1500	....	2.3	....	59	N. 19° W.	19.8	
3 04	1692	616.1	2.2	0.1	76	N. 13° W.	23.7	Balloon in clouds.
....	2000	....	1.0	....	79	....	....	
....	2500	....	− 1.0	....	85	....	....	
....	3000	....	− 3.1	....	90	....	....	
....	3500	....	− 5.3	....	96	....	....	
3 11	3629	482.7	− 5.8	0.4	97	....	....	
....	4000	....	− 8.8	....	95	....	....	
....	4500	....	−12.6	....	92	....	....	
....	5000	....	−16.4	....	89	....	....	
3 17	5635	370.7	−21.2	0.8	85	....	....	Inversion.
3 18	5894	357.9	−21.1	0.0	76	....	....	
....	6000	....	−21.9	....	75	....	....	
....	7000	....	−30.5	....	63	....	....	
....	8000	....	−38.0	....	50	....	....	
3 25	8045	264.1	−38.4	0.8	49	....	....	

OCTOBER 11, 1909.

3 09	312	735.0	4.6	....	59	N. 24° W.	16.7	
....	500	....	2.0	....	60	N. 24° W.	16.7	4/10 St.-Cu. NW.
....	1000	....	− 4.8	....	61	N. 24° W.	16.7	
3 12	1100	665.9	− 6.2	1.4	62	N. 24° W.	16.7	Lt. snow.
....	1500	....	−11.9	....	70	N. 28° W.	18.4	
....	2000	....	−16.8	....	80	N. 32° W.	20.0	
3 16	2080	586.9	−17.7	1.2	84	N. 35° W.	21.2	Balloon in clouds.
....	2500	....	−21.3	....	78	....	....	
....	3000	....	−25.6	....	72	....	....	
....	3500	....	−30.0	....	65	....	....	
3 22	3598	477.6	−30.8	0.9	63	....	....	Isothermal.
3 23	3806	463.8	−30.8	0.0	58	....	....	
....	4000	....	−32.2	....	55	....	....	
....	4500	....	−35.8	....	50	....	....	
3 28	4965	395.0	−39.2	0.7	46	....	....	Isothermal.
....	5000	....	−39.2	....	46	....	....	
3 29	5075	387.6	−39.2	0.0	46	....	....	
....	6000	....	−44.1	....	44	....	....	
....	7000	....	−49.4	....	42	....	....	
3 36	7281	284.0	−50.8	0.5	41	....	....	Inversion.
3 37	7562	271.8	−50.4	−0.1	41	....	....	
....	8000	....	−51.9	....	40	....	....	
3 42	8582	234.2	−53.8	0.3	38	....	....	
....	9000	....	−53.0	....	38	....	....	
3 45	9564	202.9	−51.9	−0.2	38	....	....	
....	10000	....	−52.2	....	34	....	....	
3 48	10161	184.3	−52.3	0.1	32	....	....	
....	11000	....	−51.7	....	....	....	....	
3 53	11508	149.4	−51.4	−0.1	....	....	....	
....	12000	....	−52.4	....	....	....	....	
....	13000	....	−54.6	....	....	....	....	
3 58	13140	116.7	−54.8	0.2	....	....	....	Inversion.
4 01	13661	108.3	−52.8	−0.4	30	....	....	
....	14000	....	−53.1	....	29	....	....	
4 05	14674	92.0	−53.6	0.1	28	....	....	
....	15000	....	−53.7	....	28	....	....	
4 09	15791	77.7	−53.8	0.0	28	....	....	
....	16000	....	−53.6	....	28	....	....	
4 12	16885	66.4	−52.5	−0.1	29	....	....	
....	17000	....	−52.4	....	28	....	....	
....	18000	....	−51.8	....	26	....	....	
4 15	18041	55.2	−51.8	−0.1	26	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, OMAHA—Continued.

OCTOBER 12, 1909.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
2 33	312	735.0	3.2	....	48	N. 61° W.	7.8	
....	500	....	1.3	....	47	N. 61° W.	7.8	5/10 Cu. NNW.
....	1000	....	− 3.7	....	47	N. 61° W.	7.8	
2 36	1209	656.6	− 5.8	1.0	46	N. 61° W.	7.8	
....	1500	....	− 8.4	....	56	N. 61° W.	8.4	
2 40	1819	607.0	−11.3	0.9	67	N. 61° W.	9.2	Inversion.
....	2000	....	− 9.3	....	52	N. 57° W.	12.0	
2 41	2045	589.4	− 8.8	−1.1	48	N. 55° W.	14.1	
....	2500	....	−10.3	....	44	N. 56° W.	16.2	
....	3000	....	−11.9	....	36	N. 58° W.	18.0	
2 46	3263	502.9	−12.8	0.3	33	N. 59° W.	19.3	Balloon in clouds.
....	3500	....	−13.4	....	31	....	....	
....	4000	....	−14.6	....	28	....	....	
2 50	4185	445.3	−15.0	0.2	26	....	....	
....	4500	....	−16.5	....	25	....	....	
....	5000	....	−18.8	....	24	....	....	
2 53	5036	397.3	−19.0	0.5	23	....	....	
2 56	5951	350.9	−23.9	0.5	23	....	....	
....	6000	....	−24.0	....	23	....	....	
2 59	6835	310.9	−24.2	0.0	23	....	....	
....	7000	....	−25.2	....	22	....	....	
3 04	7998	264.5	−31.2	0.6	19	....	....	
....	9000	....	−37.7	....	21	....	....	
3 09	9392	216.5	−40.2	0.6	22	....	....	
....	10000	....	−43.9	....	20	....	....	
....	11000	....	−49.9	....	19	....	....	
3 15	11320	162.1	−51.8	0.6	18	....	....	
....	12000	....	−52.0	....	19	....	....	
....	13000	....	−52.4	....	20	....	....	
3 20	13078	123.6	−52.4	0.0	20	....	....	Inversion.
....	14000	....	−51.5	....	20	....	....	
....	15000	....	−50.6	....	19	....	....	
....	16000	....	−49.6	....	18	....	....	
3 28	16015	78.8	−49.6	−0.1	18	....	....	
....	17000	....	−49.7	....	18	....	....	
....	18000	....	−49.8	....	18	....	....	
....	19000	....	−50.0	....	18	....	....	
3 36	19212	48.4	−50.0	0.0	18	....	....	
....	20000	....	−37.0	....	17	....	....	
3 42	20177	42.0	−33.9	−1.7	17	....	....	
....	21000	....	−31.7	....	17	....	....	
....	22000	....	−29.0	....	17	....	....	
....	23000	....	−26.3	....	17	....	....	
3 49	23653	25.9	−24.4	−0.3	17	....	....	
....	24000	....	−26.5	....	16	....	....	
3 53	**24119**	24.3	−27.2	0.3	15	....	....	

TABLE X.—*Free air data by sounding balloons* (*September, 1909–March, 1911*)—Contd.

FIRST SERIES, INDIANAPOLIS.

SEPTEMBER 27, 1909.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. h. m.	m.	mm.	°C.		Per cent.		m. p. s.	
4 23	212	748.4	14.8	....	56	N. 22° E.	3.6	2/10 Cu. N.
....	500	....	10.3	....	60	N. 14° E.	4.7	
....	1000	....	2.6	....	63	N.	6.4	
4 28	1119	670.2	0.7	1.6	64	N. 2° W.	6.8	
....	1500	....	− 5.4	....	71	N.	6.4	
4 32	1884	607.9	−11.4	1.6	78	N.	6.1	Inversion.
....	2000	....	−11.1	....	75	N.	6.8	
4 33	2091	591.8	−10.9	−0.2	72	N.	7.5	
....	2500	....	− 9.7	....	55	N. 15° E.	8.9	
....	3000	....	− 8.2	....	35	N. 15° E.	10.5	
4 39	3035	523.8	− 8.1	−0.3	34	N. 15° E.	10.6	
....	3500	....	−12.3	....	35	N. 11° E.	13.6	
....	4000	....	−16.8	....	36	N. 8° E.	16.7	
....	4500	....	−21.3	....	37	N. 4° E.	19.8	
4 49	4590	426.3	−22.1	0.9	37	N. 3° E.	20.3	
4 51	5034	401.6	−23.1	0.2	36	N.	20.3	
4 54	5534	374.6	−28.0	1.0	30	N.	21.4	
....	6000	....	−32.5	....	28	N.	23.4	
4 58	6288	337.1	−35.2	1.0	27	N.	24.6	Balloon burst.

SEPTEMBER 28, 1909.

4 53	212	743.2	17.6	....	54	S. 45° W.	4.5	
....	500	....	16.9	....	....	S. 45° W.	4.5	6/10 A.-Cu. W.
....	1000	....	15.7	....	....	S. 61° W.	4.6	
....	1500	....	14.5	....	....	S. 77° W.	4.7	
....	2000	....	13.3	....	....	N. 88° W.	4.8	
5 00	2071	597.2	13.1	0.2	....	N. 88° W.	4.8	
....	2500	....	9.8	....	....	N. 82° W.	5.0	
....	3000	....	6.0	....	....	N. 72° W.	5.3	
....	3500	....	2.1	....	....	N. 58° W.	5.5	
5 05	3581	497.2	1.5	0.8	....	N. 55° W.	5.7	
....	4000	....	0.1	....	....	N. 55° W.	5.5	
....	4500	....	− 1.6	....	....	N. 55° W.	5.3	
5 09	4782	428.1	− 2.5	0.3	....	N. 55° W.	5.2	Inversion. Balloons in clouds.
5 10	5001	416.2	− 2.1	−0.2	....	....	....	
....	6000	....	− 8.5	....	....	....	....	
5 14	6027	365.4	− 8.7	0.7	....	....	....	
....	7000	....	−15.2	....	....	....	....	
5 18	7030	320.6	−15.4	0.7	....	....	....	
....	8000	....	−23.4	....	....	....	....	
5 23	8058	279.2	−23.9	0.8	....	....	....	
....	9000	....	−29.3	....	....	....	....	
5 27	9067	243.2	−29.7	0.6	....	....	....	
....	10000	....	−34.0	....	....	....	....	
5 33	10129	209.2	−34.6	0.5	....	....	....	
....	11000	....	−39.8	....	....	....	....	
5 40	11129	181.2	−40.6	0.6	....	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, INDIANAPOLIS—Continued.

SEPTEMBER 30, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 50	212	743.5	17.2	....	58	N.	5.4	2/10 St.-Cu. NW.
....	500	....	14.6	....	64	N. 72° W.	5.9	
....	1000	....	10.0	....	74	N. 72° W.	6.2	
....	1500	....	5.3	....	84	N. 72° W.	7.3	
....	2000	....	0.8	....	94	N. 72° W.	8.4	
3 57	2026	596.8	0.6	0.9	95	N. 72° W.	8.4	Inversion.
....	2500	....	3.1	....	70	N. 56° W.	10.8	
4 02	2982	530.5	5.6	−0.5	44	N. 40° W.	13.3	
....	3000	....	5.5	....	44	N. 40° W.	13.3	
....	3500	....	2.4	....	39	N. 44° W.	14.7	
....	4000	....	− 0.6	....	34	N. 47° W.	16.1	
4 10	4385	445.2	− 3.0	0.6	30	N. 50° W.	17.3	
....	4500	....	− 3.8	....	30	N. 51° W.	17.3	
....	5000	....	− 8.0	....	30	N. 55° W.	17.4	
....	6000	....	−16.6	....	29	N. 63° W.	17.5	
4 21	6030	360.0	−16.8	0.8	29	N. 63° W.	17.5	
....	7000	....	−24.8	....	29	N. 64° W.	16.9	
4 29	7264	304.6	−28.9	0.8	29	N. 64° W.	16.7	Balloon in clouds.
....	8000	....	−33.0	....	29	....	....	
4 37	8535	255.2	−37.4	0.8	29	....	....	
....	9000	....	−40.3	....	29	....	....	
4 52	9996	206.1	−46.5	0.6	29	....	....	Inversion.
4 58	10980	178.1	−46.0	−0.1	29	....	....	
....	12000	....	−50.0	....	29	....	....	
5 06	12538	141.5	−52.3	0.4	29	....	....	
....	13000	....	−53.4	....	29	....	....	
....	14000	....	−55.6	....	29	....	....	
5 20	14605	102.8	−56.9	0.2	29	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, INDIANAPOLIS—Continued.

OCTOBER 30, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 35	212	747.7	20.9	....	43	N. 45° E.	3.6	Cloudless.
....	500	....	17.1	....	....	N. 56° E.	3.8	
....	1000	....	14.9	....	....	N. 56° E.	4.2	
....	1500	....	11.2	....	....	N. 56° E.	4.6	
3 42	1799	619.5	9.0	0.7	....	N. 56° E.	4.8	
....	2000	....	8.5	....	....	N. 60° W.	4.9	
....	2500	....	7.4	....	....	N. 60° W.	5.2	
3 50	2812	547.6	6.7	0.2	....	N. 60° W.	5.4	
....	3000	....	5.4	....	....	N. 59° W.	6.4	
....	3500	....	2.1	....	....	N. 58° W.	9.0	
....	4000	....	− 1.3	....	....	N. 56° W.	11.6	
4 01	4408	449.0	− 3.9	0.7	....	N. 55° W.	13.6	
....	4500	....	− 4.7	....	....	N. 55° W.	13.6	
....	5000	....	− 8.4	....	....	N. 54° W.	13.8	
4 10	5650	382.7	−13.4	0.8	....	N. 51° W.	13.9	
....	6000	....	−15.7	....	....	N. 51° W.	17.2	
4 14	6387	346.8	−18.2	0.7	....	N. 51° W.	20.4	
....	7000	....	−22.7	....	....	N. 51° W.	20.2	
....	8000	....	−30.1	....	....	N. 50° W.	20.0	
4 27	8199	270.3	−31.6	0.7	....	N. 50° W.	20.0	
....	9000	....	−37.0	....	....	N. 50° W.	23.9	
4 37	9821	213.9	−42.4	0.7	....	N. 50° W.	27.8	
....	10000	....	−43.6	....	....	N. 50° W.	28.1	
....	11000	....	−50.2	....	....	N. 50° W.	29.9	
4 46	11632	162.4	−54.3	0.7	....	N. 50° W.	30.9	Inversion.
....	12000	....	−54.2	....	....	N. 50° W.	31.7	
....	13000	....	−53.8	....	....	N. 50° W.	33.6	
4 53	13475	122.0	−53.6	0.0	....	N. 50° W.	34.6	
....	14000	....	−53.8	....	....	N. 50° W.	31.3	
....	15000	....	−54.1	....	....	N. 50° W.	25.3	
5 01	15457	89.5	−54.3	0.0	....	N. 50° W.	22.2	
....	16000	....	−55.8	....	....	N. 50° W.	16.3	
5 07	16735	73.4	−58.4	0.3	....	N. 50° W.	6.9	Inversion.
....	17000	....	−58.2	....	....	N. 50° W.	6.5	
....	18000	....	−57.3	....	....	N. 50° W.	5.2	
5 16	18307	57.3	−57.0	−0.1	....	N. 50° W.	4.8	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FIRST SERIES, INDIANAPOLIS—Continued.

OCTOBER 5, 1909.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
3 22	212	749.9	18.8	....	47	N. 22° E.	3.1	
....	500	....	16.1	....	51	N. 26° E.	3.5	Cloudless.
....	1000	....	11.6	....	57	N. 33° E.	4.3	
3 26	1238	663.7	9.6	0.9	60	N. 36° E.	4.6	Inversion.
....	1500	....	10.1	....	50	N. 45° E.	6.2	
3 28	1834	617.7	10.8	−0.2	39	N. 55° E.	7.9	
....	2000	....	9.8	....	36	N. 51° E.	7.4	
....	2500	....	6.8	....	29	N. 41° E.	6.1	
....	3000	....	3.7	....	23	N. 32° E.	4.8	
3 33	3143	526.6	2.8	0.6	21	N. 30° E.	4.5	
....	3500	....	0.6	....	21	N. 25° E.	5.0	
....	4000	....	− 2.4	....	21	N. 18° E.	5.8	
3 38	4432	448.0	− 5.0	0.6	21	N. 13° E.	6.3	
....	4500	....	− 5.6	....	....	N. 13° E.	6.6	
....	5000	....	− 9.6	....	....	N. 12° E.	7.8	
....	6000	....	−17.5	....	....	N. 10° E.	10.1	
3 48	6463	343.5	−21.2	0.8	....	N. 9° E.	11.3	
....	7000	....	−25.5	....	....	N. 9° E.	12.0	
3 53	7454	299.9	−29.1	0.8	....	N. 9° E.	12.5	
....	8000	....	−33.0	....	....	N. 8° E.	11.9	
4 02	9006	240.8	−39.8	0.7	....	N. 7° E.	10.9	
....	10000	....	−45.9	....	....	N. 6° E.	15.2	
4 10	10347	197.9	−48.0	0.6	....	N. 6° E.	16.5	
....	11000	....	−49.2	....	....	N. 4° W.	16.7	
4 16	11232	173.4	−49.6	0.2	....	N. 4° W.	16.7	Inversion.
....	12000	....	−49.5	....	....	N. 10° W.	18.3	
....	13000	....	−49.5	....	....	N. 18° W.	20.3	
4 30	13580	121.8	−49.4	0.0	....	N. 22° W.	21.5	
4 36	14011	114.3	−45.4	−1.0	....	N. 34° W.	14.7	
4 44	**14482**	106.8	−39.0	−1.4	....	N. 44° W.	20.8	

OCTOBER 6, 1909.

2 57	212	748.4	22.4	....	74	S. 70° E.	2.2	
....	500	....	19.9	....	77	S. 67° E.	2.0	
....	1000	....	15.6	....	82	S. 62° E.	1.7	Cloudless.
3 05	1507	642.4	11.2	0.9	86	S. 58° E.	1.3	
3 08	1997	602.9	11.2	0.0	57	S. 45° E.	2.5	
....	2500	....	7.6	....	51	S. 62° E.	3.2	
3 12	3000	....	4.0	0.7	45	S. 78° E.	4.0	
....	3500	....	0.4	....	39	N. 35° E.	4.3	
....	4000	....	− 3.1	....	34	N. 35° E.	4.6	
3 17	4026	471.8	− 3.3	0.7	34	N. 35° E.	4.8	
....	4500	....	− 7.4	....	34	N. 35° E.	4.5	
3 23	5000	....	−11.5	0.8	34	N. 35° E.	4.2	
....	6000	....	−19.9	....	34	N. 54° E.	4.0	
3 30	6306	349.8	−22.4	0.8	34	N. 60° E.	4.0	
....	7000	....	−27.6	....	34	N. 60° E.	4.0	
3 34	7043	320.7	−27.9	0.7	34	N. 60° E.	4.0	
3 39	8000	....	−36.4	0.9	34	N. 75° E.	7.1	
3 43	9000	....	−45.2	0.9	34	N. 65° E.	10.8	
....	10000	....	−54.1	....	34	N. 71° E.	10.2	
3 49	10251	196.8	−56.3	0.9	34	N. 72° E.	10.1	
3 53	11000	....	−58.6	0.3	34	N. 59° E.	11.9	
3 58	12000	....	−61.6	0.3	34	N. 25° E.	10.0	
....	13000	....	−64.8	....	34	N. 15° W.	9.6	
4 04	13081	125.0	**−65.0**	0.3	34	N. 15° W.	9.6	Inversion.
4 08	14000	....	−63.8	−0.1	34	N. 20° W.	10.6	
4 13	15000	....	−62.5	−0.1	34	N. 50° W.	4.5	
....	16000	....	−60.9	....	34	N. 73° W.	5.0	
4 20	16297	74.4	−60.4	−0.2	34	N. 80° W.	5.2	
....	17000	....	−58.3	....	34	N. 65° W.	4.0	
....	18000	....	−55.2	....	34	N. 40° W.	2.6	
....	19000	....	−51.9	....	34	N. 24° W.	2.2	
4 35	**19448**	45.2	−50.4	−0.3	34	N. 24° W.	2.3	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

SECOND SERIES, OMAHA.

MAY 6, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,\text{m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 56	312	735.0	8.8	....	98	N. 63° E.	5.4	10/10 St. E. Heavy rain.
....	500	....	7.0	....	95	N. 70° E.	5.9	
4 58	579	711.6	6.2	1.0	93	N. 74° E.	6.1	Balloon in clouds.
5 02	988	676.9	8.7	0.8	91	....	....	

MAY 7, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,\text{m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
5 29	312	732.9	12.0	....	63	N. 69° E.	2.7	
....	500	....	9.9	....	65	N. 69° E.	3.0	
....	1000	....	4.2	....	72	N. 69° E.	3.5	
5 34	1048	670.3	3.6	1.1	74	N. 69° E.	3.7	9/10 A-St. N.
....	1500	....	0.4	....	77	N. 38° E.	7.0	
5 40	1975	597.2	− 3.0	0.7	80	N. 7° E.	10.3	
....	2000	....	− 3.2	....	78	N. 7° E.	10.5	
....	2500	....	− 6.3	....	62	N. 10° E.	15.0	
5 43	2554	554.7	− 6.6	0.6	58	N. 11° E.	15.8	
5 45	2922	529.0	− 6.9	0.1	86	N. 13° E.	19.8	Balloon in clouds.
....	3000	....	− 7.1	....	87	....	....	
....	3500	....	− 8.6	....	88	....	....	
5 50	3708	478.2	− 9.2	0.3	89	....	....	
....	4000	....	− 9.3	....	80	....	....	
5 55	4374	438.8	− 9.4	0.0	68	....	....	
....	4500	....	−10.3	....	62	....	....	
....	5000	....	−13.8	....	56	....	....	
....	5144	395.2	−14.8	0.7	53	....	....	
6 12	5692	368.5	....	....	48	....	....	

MAY 8, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,\text{m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
5 18	312	730.2	20.1	....	42	S. 78° W.	5.4	
....	500	....	18.0	....	60	S. 76° W.	5.7	
....	1000	....	12.4	....	56	S. 73° W.	6.5	
....	1500	....	6.8	....	52	S. 70° W.	7.4	
5 25	1638	623.6	5.3	1.1	51	S. 68° W.	7.6	4/10 Ci. NW.
....	2000	....	7.3	....	36	N. 29° W.	7.0	
5 28	2083	590.6	7.8	−0.6	32	N. 29° W.	6.8	Inversion.
....	2500	....	5.5	....	30	N. 22° W.	9.1	
....	3000	....	2.8	....	26	N. 13° W.	12.0	
5 36	3211	514.4	1.5	0.6	25	N. 10° W.	13.1	
....	3500	....	− 0.3	....	26	N. 9° W.	13.7	
5 44	3962	468.5	− 1.6	0.4	28	N. 8° W.	15.0	
5 52	4092	461.0	....	....	....	N. 17° W.	16.0	

MAY 9, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,\text{m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
5 06	312	735.0	19.5	....	52	N. 21° E.	3.6	
....	500	....	18.3	....	52	N. 16° E.	3.6	
....	1000	....	15.0	....	52	N. 8° E.	3.5	
5 13	1275	656.5	13.2	0.7	52	N. 5° E.	3.5	7/10 A.-Cu. WNW.
....	1500	....	11.4	....	51	N. 5° W.	4.5	
....	2000	....	8.1	....	50	N. 30° W.	6.0	
5 19	2145	591.5	7.5	0.6	49	N. 40° W.	7.0	
....	2500	....	5.4	....	54	N. 48° W.	9.0	
....	3000	....	2.5	....	60	N. 54° W.	11.9	
....	3500	....	− 0.4	....	68	N. 63° W.	15.0	
5 29	3752	485.2	− 1.8	0.6	70	N. 69° W.	16.8	Balloon in clouds.
....	4000	....	− 2.6	....	66	....	....	
....	4500	....	− 4.1	....	60	....	....	
....	5000	....	− 5.7	....	54	....	....	
5 40	5294	399.1	− 6.6	0.3	50	....	....	
....	6000	....	−11.9	....	45	....	....	
5 47	6058	361.5	−12.8	0.7	43	....	....	
5 50	6070	359.8	....	....	40	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

SECOND SERIES, OMAHA—Continued.

MAY 10, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
5 02	312	728.6	24.8		62	N. 87° E.	2.7	
	500		23.3		64	N. 87° E.	2.8	
	1000		19.1		68	N. 87° E.	3.2	
5 08	1162	660.6	17.9	0.8	70	S. 37° E.	3.3	10/10 A.-St. SW.
5 09	1282	651.5	18.1	−0.2	63	S. 34° W.	5.7	Inversion.
	1500		16.6		64	S. 37° W.	7.5	
	2000		12.8		76	S. 44° W.	12.0	
	2500		9.1		89	S. 51° W.	16.5	
5 18	2756	547.0	7.3	0.7	91	S. 55° W.	19.2	Balloon in clouds.
	3000		5.8		87			
	3500		2.5		74			
5 25	3742	484.4	1.1	0.6	70			
	4000		− 1.0		64			
5 32	4450	443.2	− 4.6	0.8	57			
	4500		− 4.9		59			
5 41	**4901**	418.0	**− 8.0**	0.6	70			

MAY 11, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind direction.	Wind velocity.	Remarks.
5 18	312	736.0	15.0		38	N. 1° W.	10.7	
	500		13.4		40	N. 2° W.	10.6	
	1000		9.0		43	N. 4° W.	10.5	
5 24	1135	667.2	7.8	0.9	45	N. 5° W.	10.4	8/10 A.-Cu. NNW.
	1500		4.2		48	N. 10° W.	10.1	
5 30	1757	618.2	1.6	1.0	54	N. 15° W.	9.8	Inversion.
	2000		2.0		52	N. 20° W.	10.8	
5 35	2369	573.3	2.7	−0.2	49	N. 25° W.	12.1	Balloon in clouds.
	2500		1.9		55			
	3000		− 1.0		66			
	3500		− 3.9		76			
5 46	3707	484.8	− 5.1	0.6	83			
5 47	3841	476.7	− 5.6	0.4	81			
	4000		− 6.4		81			
	4500		− 9.1		81			
5 55	4518	437.1	− 9.2	0.5	81			
6 05	**4856**	418.4	**−11.8**	0.6	88			

MAY 12, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind direction.	Wind velocity.	Remarks.
5 01	312	741.3	15.1		31	N. 6° E.	7.2	
	500		13.2		32	N. 2° E.	7.4	Cloudless.
	1000		8.2		33	N. 6° W.	7.8	
5 08	1151	670.5	6.7	1.0	34	N. 10° W.	8.0	
	1500		3.8		35	N. 13° W.	8.1	
	2000		− 0.3		37	N. 17° W.	8.4	
5 15	2088	597.1	− 1.1	0.8	37	N. 18° W.	8.4	
5 18	2525	565.3	− 1.5	0.1	30	N. 34° W.	12.1	
	3000		− 3.3		33	N. 35° W.	13.5	
	3500		− 5.2		36	N. 37° W.	14.9	
5 29	3963	471.1	− 6.9	0.4	39	N. 38° W.	16.2	
	4000		− 7.2		39	N. 38° W.	17.0	
	4500		−10.4		36	N. 35° W.	26.2	
5 31	4589	434.5	−11.0	0.7	35	N. 34° W.	28.2	
	5000		−12.8		35	N. 34° W.	27.7	
	6000		−17.1		35	N. 36° W.	26.4	
5 42	6292	346.9	−18.3	0.4	35	N. 30° W.	26.0	Disappeared.
	7000		−20.9		35			
5 53	**7979**	275.5	**−24.4**	0.4	34			

TABLE X.—*Free air data by sounding balloons (September, 1909-March, 1911)*—Contd.

SECOND SERIES, OMAHA—Continued.

MAY 13, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. h. m.	m.	mm.	°C.		Per cent.		m. p. s.	
5 31	312	739.4	18.1	....	35	S. 13° E.	2.2	
....	500	....	15.5	....	36	S. 15° E.	2.3	
....	1000	....	8.7	....	38	S. 20° E.	2.7	
5 37	1015	680.2	8.5	1.4	38	S. 20° E.	2.7	2/10 Ci.-St. W.
....	1500	....	5.1	....	40	N. 18° W.	6.0	
5 42	1904	610.2	2.2	0.7	42	N. 18° W.	8.5	
....	2000	....	1.7	....	42	N. 18° W.	8.6	
....	2500	....	− 0.7	....	43	N. 18° W.	9.5	
5 46	2712	551.7	− 1.7	0.5	44	N. 18° W.	9.8	
....	3000	....	− 3.4	....	43	N. 21° W.	10.4	
....	3500	....	− 6.2	....	42	N. 26° W.	11.4	
....	4000	....	− 8.9	....	40	N. 32° W.	12.5	
5 55	4097	462.3	− 9.5	0.6	40	N. 33° W.	12.7	
....	4500	....	−11.7	....	38	N. 33° W.	13.5	
....	5000	....	−14.6	....	36	N. 31° W.	14.6	
6 05	5172	401.7	−15.6	0.6	35	N. 31° W.	15.0	
6 17	5658	376.7	....	....	30	N. 30° W.	18.2	

MAY 15, 1910.

4 59	312	730.4	12.4	....	89	S. 35° W.	3.1	10/10 St. SW. Lt. rain.
....	500	....	7.9	....	94	S. 24° W.	6.2	
5 01	522	712.2	7.5	2.2	94	S. 24° W.	6.2	Balloon in clouds.
....	1000	....	5.2	....	91	....	....	
5 09	1413	638.7	3.1	0.5	89	....	....	Inversion.
....	1500	....	3.6	....	86	....	....	
5 11	1901	601.6	6.0	−0.6	72	....	....	
....	2000	....	5.5	....	68	....	....	
....	2500	....	2.9	....	55	....	....	
....	3000	....	0.4	....	43	....	....	
5 21	3362	502.2	− 1.4	0.5	27	....	....	
....	3500	....	− 2.5	....	27	....	....	
....	4000	....	− 6.7	....	27	....	....	
5 29	4427	438.3	−10.0	0.8	27	....	....	
....	5000	....	....	....	....	....	....	
5 38	5162	398.6	....	....	17	....	....	

MAY 17, 1910.

4 54	312	735.0	18.2	....	38	N. 56° W.	6.3	
....	500	....	15.3	....	38	N. 54° W.	6.8	Cloudless.
4 58	861	688.8	9.8	1.5	39	N. 52° W.	7.8	
....	1000	....	8.4	....	41	N. 53° W.	8.6	
5 03	1374	647.1	4.7	1.0	46	N. 54° W.	10.0	
....	1500	....	4.1	....	46	N. 55° W.	10.2	
....	2000	....	1.8	....	47	N. 56° W.	10.5	
5 09	2222	582.9	0.8	0.5	47	N. 57° W.	10.7	
....	2500	....	....	....	34	N. 48° W.	12.5	
5 20	2759	545.3	....	....	21	N. 40° W.	15.6	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

SECOND SERIES, OMAHA—Continued.

MAY 18, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
a. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
7 22	312	736.2	9.8	....	84	S. 43° W.	0.9	Inversion.
....	500	....	15.0	....	55	....	3.5	
7 24	573	713.8	16.1	−2.4	43	S. 43° W.	4.2	
....	1000	....	12.8	....	40	S. 51° W.	5.0	
....	1500	....	9.1	....	36	S. 60° W.	5.8	Cloudless.
7 34	1816	615.2	6.6	0.8	33	S. 67° W.	6.3	
....	2000	....	6.3	....	31	S. 85° W.	5.5	
7 38	2303	579.8	6.0	0.1	30	N. 79° W.	3.9	
....	2500	....	5.0	....	28	N. 85° W.	4.2	
....	3000	....	2.5	....	24	S. 89° W.	4.8	
7 47	3461	502.6	0.0	0.5	22	S. 83° W.	5.7	
....	3500	....	−0.2	....	25	S. 85° W.	6.0	
....	4000	....	−1.8	....	27	N. 89° W.	10.2	
....	4500	....	−3.4	....	29	N. 85° W.	14.5	
7 56	4757	427.0	−4.4	0.3	30	N. 81° W.	16.1	
....	5000	....	....	....	30	N. 70° W.	14.0	
8 07	5665	380.5	....	....	31	N. 43° W.	8.2	Disappeared.

MAY 19, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Direction.	Velocity.	Remarks.
7 07	312	728.6	15.4	....	78	S. 8° W.	4.0	
....	500	....	13.0	....	78	S. 9° W.	7.0	
7 10	594	704.7	11.8	1.3	78	S. 10° W.	8.5	4/10 Ci. W. Inversion.
7 11	700	695.8	12.6	−0.1	75	S. 27° W.	12.5	
....	1000	....	10.5	....	75	S. 26° W.	12.6	
....	1500	....	7.5	....	74	S. 24° W.	12.7	
7 18	1654	620.3	6.6	0.6	74	S. 24° W.	12.7	
....	2000	....	4.9	....	77	S. 20° W.	12.6	
....	2500	....	2.7	....	83	S. 14° W.	12.5	
7 25	2530	557.0	2.5	0.5	83	S. 14° W.	12.5	
....	3000	....	−0.7	....	82	S. 25° W.	10.8	
7 33	3287	506.8	−2.4	0.6	82	S. 32° W.	9.8	
....	3500	....	....	....	75	S. 37° W.	9.6	
7 44	3777	476.3	....	....	64	S. 44° W.	9.2	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

SECOND SERIES, OMAHA—Continued.

MAY 19, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	° *C.*		*Per cent.*		*m. p. s.*	
5 20	312	725.8	18.2		82	S. 14° E.	3.1	2/10 Ci. W.; 7/10 St.-Cu. S.
	500		16.3		83	S. 11° E.	4.7	
5 24	916	675.9	12.4	0.9	86	S. 5° E.	7.9	Inversion.
5 25	952	673.0	12.7	−0.9	83	S. 22° W.	8.9	
	1000		12.4		83	S. 22° W.	8.8	
	1500		8.9		81	S. 29° W.	7.7	
5 31	1975	595.1	6.1	0.6	80	S. 36° W.	6.6	Inversion.
	2000		6.3		78	S. 40° W.	5.6	
5 32	2033	590.9	6.6	−0.9	75	S. 48° W.	3.7	
	2500		4.3		77	S. 76° W.	5.4	
5 36	2646	548.3	3.6	0.5	77	S. 81° W.	5.7	Balloon in clouds.
	3000		2.0		73			
5 41	3374	501.0	0.1	0.5	69			
	3500		− 0.8		69			
	4000		− 4.2		70			
5 46	4423	438.6	− 7.2	0.7	71			
	4500		− 7.7		69			
	5000		−10.7		57			
5 52	5336	389.7	−12.7	0.6	51			
	6000		−16.7		50			
5 58	6264	344.7	−19.5	0.7	50			
	7000		−24.1		44			
6 04	7306	299.1	−25.9	0.6	42			
	8000		−31.1		41			
6 11	8395	257.1	−34.3	0.8	40			
	9000		−39.1		40			
6 15	9109	232.0	−39.9	0.8	40			
	10000		−46.8		37			
6 22	10218	197.3	−48.5	0.8	36			
6 24	10612	186.0	−49.4	0.2	36			
	11000		−51.0		36			
	12000		−54.7		35			
6 32	12156	147.3	−55.3	0.4	35			Inversion.
6 33	12293	144.1	−53.7	−1.0	35			
	13000		−55.3		35			
6 41	13821	113.9	−57.0	0.2	34			
	14000		−56.6					
	15000		−55.2					
6 48	15473	88.3	−54.2	−0.2	34			
	16000		−56.3		33			
6 53	16634	73.7	−58.7	0.4	32			
6 54	17004	69.6	−57.8	−0.2	32			Clock stopped at 6:54 p. m.
	25333	18.9			24			Greatest altitude computed from lowest point reached by pressure pen.
			−60.2					

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

SECOND SERIES, OMAHA—Continued.

MAY 20, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
a. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
6 55	312	725.1	15.0	....	98	S. 5° E.	3.6	Inversion. 1/10 St.-Cu., W.
....	500	....	15.3	....	92	S. 5° E.	3.1	Lt. fog.
7 00	981	670.3	16.1	−0.2	79	Calm.	0.0	
7 03	1442	635.1	17.2	−0.2	63	N. 68° W.	8.6	
....	1500	....	16.7	....	63	N. 69° W.	8.6	
....	2000	....	12.8	0.8	60	N. 81° W.	9.4	
7 09	2349	570.4	10.0	0.8	58	N. 88° W.	9.8	
....	2500	....	9.0	....	58	N. 89° W.	10.7	
....	3000	....	5.2	....	59	S. 84° W.	12.9	
7 15	3220	513.2	3.7	0.7	59	S. 82° W.	13.8	Disappeared.
....	3500	....	1.7	....	59	....	....	
....	4000	....	− 1.9	....	59	....	....	
7 22	4062	461.2	− 2.5	0.7	59	....	....	
....	4500	....	....	....	....	....	....	
7 29	4761	423.1	− 6.4	0.6	64	....	....	

MAY 21, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Direction.	Velocity.	Remarks.
p. m.								
5 19	312	731.0	12.6	....	85	N. 1° E.	8.0	10/10 St. N.
....	500	....	11.1	....	90	N. 1° E.	8.2	
5 21	658	701.4	9.8	0.8	94	N. 2° E.	8.6	Balloon in clouds.
....	1000	....	7.4	....	88	....	....	Inversion.
5 24	1079	666.6	6.9	0.7	87	....	....	
5 26	1356	644.6	9.2	−0.8	82	....	....	
....	1500	....	8.6	....	81	....	....	
....	2000	....	7.0	....	78	....	....	
....	2500	....	5.3	....	75	....	....	
5 35	2793	541.3	4.2	0.4	73	....	....	
....	3000	....	3.0	....	73	....	....	
....	3500	....	0.2	....	77	....	....	Inversion.
5 42	4013	465.1	− 2.8	0.6	79	....	....	
5 44	4162	456.3	− 2.6	−0.1	62	....	....	
....	4500	....	− 4.9	....	55	....	....	
5 48	4857	417.8	− 7.0	0.6	46	....	....	
....	5000	....	....	....	....	....	....	
5 56	5575	380.9	....	....	43	....	....	

MAY 22, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Direction.	Velocity.	Remarks.
5 46	312	732.2	18.2	....	51	N. 6° W.	4.5	
....	500	....	18.0	....	53	N. 2° W.	4.8	
....	1000	....	10.5	....	56	N. 1° E.	5.2	
5 51	1135	664.2	9.0	1.1	58	N. 4° E.	5.5	10/10 Ci.-St. W.
....	1500	....	5.9	....	68	N. 1° W.	5.7	
5 54	1801	612.4	3.3	0.9	77	N. 5° W.	5.8	Inversion.
5 56	1934	602.5	3.8	−0.4	57	N. 15° W.	13.3	
....	2000	....	3.6	....	57	N. 14° W.	12.0	
6 00	2398	568.9	2.3	0.3	56	N. 10° W.	4.9	
....	2500	....	1.8	....	58	N. 20° W.	4.8	
....	3000	....	− 0.7	....	63	N. 35° W.	4.8	
....	3500	....	− 3.2	....	68	N. 50° W.	4.7	
6 09	3571	491.4	− 3.6	0.5	70	N. 58° W.	4.7	
....	4000	....	− 6.9	....	66	N. 61° W.	5.2	
6 17	4332	445.8	− 9.5	0.8	63	N. 64° W.	5.7	
....	4500	....	−10.5	....	62	N. 64° W.	5.7	
6 26	4988	409.3	−13.3	0.6	60	N. 65° W.	5.8	
....	5000	....	−13.3	....	55	N. 66° W.	5.5	
6 34	5019	406.5	−13.4	0.4	47	N. 74° W.	4.6	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON.

AUGUST 10, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
5 15.5	392	725.8	27.0	....	52	S.	5.8	
....	500	....	25.9	....	53	S.	6.8	
5 18.7	984	678.0	21.6	0.9	54	S. 17° E.	8.8	7/10 Cu. SW.
....	1000	....	21.4	....	55	S. 14° E.	8.5	
....	1500	....	17.2	....	57	S. 7° E.	6.2	
5 22.0	1534	....	16.9	....	58	S. 5° E.	6.0	4/10 Cu.-Nb. SW. 5/10 A.-St. N.
5 24.0	1867	....	14.2	....	60	S. 32° W.	8.3	
....	2000	....	13.1	....	63	S. 38° W.	7.6	
5 26.4	2266	583.1	10.8	0.8	65	S. 49° W.	6.2	
....	2500	....	9.2	....	68	S. 62° W.	5.4	
....	3000	....	5.1	....	75	S. 85° W.	3.5	
5 30.0	3190	....	3.5	....	78	N. 83° W.	2.7	
....	3500	....	1.0	....	82	N. 65° W.	3.4	Balloon in clouds.
5 33.1	3985	471.8	− 3.2	0.8	85	N. 54° W.	4.2	
....	4000	....	− 3.3	....	84	....	....	
....	4500	....	− 5.6	....	80	....	....	Thunder in NW. at 5:34 p.m
5 38.3	4961	416.6	− 7.9	0.5	77	....	....	Inversion.
....	5000	....	− 7.8	....	77	....	....	
5 38.8	5036	412.6	− 7.8	−0.1	77	....	....	
....	6000	....	−15.8	....	62	....	....	
5 42.9	6098	359.4	−16.3	0.8	60	....	....	
....	7000	....	−23.8	....	60	....	....	
5 49.0	7146	312.5	−24.9	0.8	60	....	....	
....	8000	....	−30.4	....	61	....	....	
5 55.7	8722	250.8	−35.2	0.6	63	....	....	
....	9000	....	−36.5	....	63	....	....	
....	10000	....	−41.2	....	61	....	....	
6 03.5	10045	207.3	−41.5	0.5	61	....	....	
....	11000	....	−47.3	....	60	....	....	
....	11867	158.3	−52.6	0.6	60	....	....	
....	12000	....	−52.3	....	59	....	....	
....	13000	....	−50.6	....	58	....	....	
....	13527	123.7	−49.8	−0.2	57	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

AUGUST 11, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
5 00.5	392	726.0	30.7	....	43	S.	5.8	
....	500	....	29.6	....	42	S.	6.4	
....	1000	....	25.8	....	40	S.	7.5	Cloudless.
5 07.1	1375	649.1	23.6	0.7	38	S.	8.1	Inversion.
5 07.6	1478	641.5	23.7	−0.1	36	S.	7.6	
....	1500	....	23.7	....	34	S.	7.0	
....	2000	....	21.3	....	25	S. 34° W.	2.5	
5 11.1	2013	603.1	21.3	0.4	22	S. 36° W.	1.9	
....	2500	....	16.3	....	25	N. 75° W.	3.6	
5 15.0	2674	....	14.6	....	27	N. 49° W.	4.2	
....	3000	....	11.7	....	29	N. 46° W.	6.5	
5 17.0	3012	....	11.6	....	29	N. 42° W.	6.8	
5 19.0	3351	....	8.3	....	31	N. 40° W.	8.2	
....	3500	....	7.1	....	33	N. 35° W.	8.9	
5 21.3	3741	490.5	4.8	1.0	35	N. 32° W.	10.1	
....	4000	....	2.7	....	35	N. 20° W.	11.0	
5 23.0	4037	....	2.4	....	35	N. 18° W.	11.2	
5 25.0	4386	....	− 0.4	....	36	N. 12° W.	15.2	
....	4500	....	− 1.3	....	36	N. 15° W.	14.8	
....	5000	....	− 5.2	....	37	N. 20° W.	13.9	
5 32.9	5762	380.2	−11.0	0.8	38	N. 29° W.	12.3	Inversion.
5 33.6	5871	375.0	−10.8	−0.2	38	N. 41° W.	11.9	
....	6000	....	−11.7	....	36	N. 42° W.	12.5	
....	7000	....	−18.0	....	33	N. 45° W.	17.0	
5 41.8	7375	307.7	−20.3	0.6	32	N. 47° W.	17.8	Cloudless.
....	8000	....	−24.8	....	31	N. 47° W.	18.8	
....	9000	....	−32.2	....	31	N. 46° W.	20.2	
5 54.3	9712	222.7	−37.2	0.7	30	N. 46° W.	21.2	Balloon disappeared.
....	10000	....	−38.2	....	30	....	....	
6 00.5	10782	190.8	−40.6	0.3	30	....	....	
6 01.3	10946	186.3	−40.7	0.1	28	....	....	
....	11000	....	−40.8	....	28	....	....	
....	12000	....	−44.3	....	28	....	....	
6 14.5	12821	141.7	−47.6	0.4	28	....	....	Inversion.
6 18.0	12949	139.1	−45.9	−1.3	28	....	....	
....	13000	....	−46.2	....	28	....	....	
6 22.2	13661	124.8	−47.7	0.3	28	....	....	
6 25.9	13948	119.9	−45.9	−0.6	26	....	....	
....	14000	....	−46.3	....	27	....	....	
6 27.2	14160	115.9	−47.3	0.7	28	....	....	
6 32.3	14447	111.1	−45.3	−0.7	29	....	....	
6 35.2	14582	108.9	−41.6	−2.7	27	....	....	

AUGUST 12, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Direction.	Velocity.	Remarks.
4 43.2	392	723.1	29.1	....	59	S.	4.5	
....	500	....	28.8	....	59	S. 2° W.	6.5	
4 50.0	[1] 896	....	....	....	....	S. 9° W.	14.6	
....	1000	....	27.1	....	57	S. 12° W.	14.4	8/10 St.-Cu. SSW. 2/10 Cu.-Nb. W.
4 47.1	1484	638.7	25.7	0.3	56	S. 25° W.	13.1	
....	1500	....	....	....	....	S. 25° W.	13.1	
....	2000	....	....	....	....	S. 26° W.	12.5	
....	2500	....	....	....	....	S. 26° W.	12.0	
....	3000	....	....	....	....	S. 26° W.	11.5	
....	3500	....	....	....	....	S. 27° W.	11.0	
4 56.0	[1] 3941	....	....	....	....	S. 27° W.	10.5	Balloon in clouds.
....	....	....	−55.8	....	....	....	....	
....	[2] 23200	27.7	....	....	....	....	....	

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[1] Altitude from rate of ascent.

[2] Temperature correction is approximate.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

AUGUST 13, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 42.2	392	728.3	25.8	....	59	E.	5.4	
....	500	....	24.7	....	62	E.	5.5	
....	1000	....	19.6	....	75	N. 25° E.	6.0	1/10 Cu. NE.
....	1500	....	14.3	....	90	N. 50° E.	6.5	
4 52.5	1765	620.1	11.8	1.0	93	N. 56° E.	6.7	Inversion.
4 53.0	1843	614.2	12.1	−0.4	82	N. 40° E.	6.1	
....	2000	....	11.5	....	75	N. 45° E.	6.2	
....	2500	....	9.5	....	58	N. 54° E.	6.5	
4 57.4	2604	560.5	8.9	0.4	54	N. 59° E.	6.6	Balloon in Cu. at intervals, 4:51 to 4:57 p. m.
....	3000	....	6.3	....	52	N. 50° E.	6.5	
....	3500	....	3.2	....	50	N. 40° E.	6.4	
5 02.9	3716	488.9	1.7	0.6	49	N. 35° E.	6.4	
5 03.5	3846	481.0	1.7	0.0	49	N. 8° E.	8.3	Disappeared in haze at 5:06 p. m.
....	4000	....	0.7	....	45	....	....	
....	4500	....	− 2.6	....	39	....	....	
5 07.9	4856	423.6	− 4.7	0.6	34	....	....	Inversion.
5 08.4	4936	419.3	− 4.5	−0.2	33	....	....	
....	5000	....	− 4.8	....	33	....	....	
....	6000	....	−11.1	....	33	....	....	
5 17.2	6669	335.1	−15.1	0.6	33	....	....	
....	7000	....	−17.7	....	35	....	....	
....	8000	....	−25.2	....	38	....	....	
5 24.0	8059	278.2	−25.3	0.7	39	....	....	
....	9000	....	−32.1	....	41	....	....	
5 31.6	9328	233.2	−34.3	0.7	41	....	....	
....	10000	....	−36.8	....	38	....	....	
5 40.0	10748	190.4	−39.5	0.4	36	....	....	1/10 Cu. NE.
....	11000	....	−40.4	....	36	....	....	
....	12000	....	−43.4	....	36	....	....	
....	**12861**	139.7	**−45.8**	0.3	36	....	....	

AUGUST 14, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
4 32.1	392	726.9	26.6	....	53	S. 45° E.	5.4	
....	500	....	25.2	....	54	S. 45° E.	5.6	
4 35.0	808	692.9	21.7	1.2	56	S. 45° E.	5.9	Cloudless; light haze.
....	1000	....	19.7	....	60	S. 44° E.	6.4	
4 39.1	1298	654.4	17.2	0.9	68	S. 43° E.	7.0	
....	1500	....	15.3	....	74	S. 40° E.	7.7	
4 40.7	1590	632.2	14.3	1.0	76	S. 39° E.	8.0	
....	2000	....	11.1	....	82	S. 35° E.	7.0	
4 44.7	2227	585.7	9.2	0.8	87	S. 32° E.	6.2	Inversion.
....	2500	....	10.6	....	64	S. 20° E.	7.0	
4 46.4	2592	560.4	10.8	−0.4	53	S. 12° E.	7.4	
....	3000	....	8.2	....	49	S. 5° W.	6.2	
4 51.0	3455	504.5	5.4	0.6	45	S. 26° W.	5.1	Balloon in Cu. at 4:53.5 p. m.
....	3500	....	4.6	....	45	....	....	
....	4000	....	1.2	....	46	....	....	1/10 Cu. SE.
....	4500	....	− 2.3	....	47	....	....	
4 56.3	4600	437.6	− 3.0	0.7	47	....	....	
....	5000	....	− 5.7	....	50	....	....	
5 01.4	5639	383.0	− 9.8	0.7	58	....	....	
5 02.2	5849	372.8	−10.3	0.2	59	....	....	
....	6000	....	−11.6	....	60	....	....	
5 03.3	6124	360.0	−12.6	0.8	60	....	....	
5 03.7	6212	355.9	−12.6	0.0	61	....	....	
....	7000	....	−19.0	....	63	....	....	
5 08.0	7243	310.2	−20.9	0.8	64	....	....	
5 08.9	7483	300.3	−21.2	0.1	60	....	....	
....	8000	....	−24.8	....	53	....	....	
5 12.1	8250	270.5	−26.3	0.7	50	....	....	
....	9000	....	−31.4	....	49	....	....	
5 16.3	**9390**	230.9	**−34.0**	0.7	48	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 1, 1910.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
4 55.2	392	725.5	20.4	....	71	S. 10° E.	5.8	
....	500	....	19.6	....	75	S. 10° E.	6.5	10 St. SSE.
....	1000	....	15.8	....	93	S. 12° E.	9.4	
5 01.3	1234	657.6	14.1	0.7	100	S. 13° E.	12.2	Balloon in St. at 5:01 p. m.
....	1500	....	13.1	....	95	....	....	
5 06.0	1984	601.4	11.4	0.4	81	....	....	
....	2000	....	11.4	....	80	....	....	
....	2500	....	11.8	....	44	....	....	
....	3000	....	12.1	....	17	....	....	
5 12.3	3098	526.6	12.2	0.1	10	....	....	
....	3500	....	9.0	....	7	....	....	
....	4000	....	5.4	....	4	....	....	
5 18.1	4214	460.0	3.7	0.8	3	....	....	
....	4500	....	1.1	....	3	....	....	
....	5000	....	− 3.0	....	4	....	....	
5 23.3	5474	392.6	− 7.3	0.9	5	....	....	
5 24.4	5758	378.4	−10.6	1.2	6	....	....	
....	6000	....	−12.2	....	6	....	....	
5 26.3	6538	341.5	−15.4	0.6	6	....	....	
....	7000	....	−18.4	....	6	....	....	
5 29.7	7596	296.6	−22.6	0.7	6	....	....	
....	8000	....	−25.5	....	6	....	....	
5 33.2	8665	256.0	−30.2	0.7	6	....	....	
....	9000	....	−32.9	....	5	....	....	
5 36.5	9627	223.6	−37.6	0.8	4	....	....	
....	10000	....	−40.0	....	4	....	....	
....	11000	....	−46.5	....	4	....	....	
5 41.2	11508	169.8	−49.9	0.6	4	....	....	
....	12000	....	−52.1	....	3	....	....	
5 44.2	12542	144.9	−54.8	−0.5	3	....	....	Inversion.
....	13000	....	−54.5	....	4	....	....	
5 48.1	13789	119.8	−53.9	0.1	4	....	....	
....	14000	....	−54.0	....	4	....	....	
....	15000	....	−54.8	....	4	....	....	
5 53.0	15182	96.8	−54.9	0.1	4	....	....	Inversion.
....	16000	....	−54.1	....	4	....	....	
....	17000	....	−53.0	....	4	....	....	
5 58.3	17127	71.7	−52.9	−0.1	4	....	....	
....	18000	....	−52.1	....	4	....	....	
....	19000	....	−51.2	....	4	....	....	
....	20000	....	−50.4	....	4	....	....	
6 05.7	20422	43.4	−50.0	−0.1	4	....	....	
....	21000	....	−48.3	....	4	....	....	
6 11.7	22000	34.4	−45.3	−0.3	3	....	....	
....	23000	....	−44.7	....	3	....	....	
....	24000	....	−43.9	....	3	....	....	
6 16.7	24444	23.9	−43.7	−0.1	3	....	....	
....	25000	....	−42.6	....	3	....	....	
....	26000	....	−41.0	....	2	....	....	
6 23.4	26892	16.6	−39.6	−0.2	2	....	....	
....	27000	....	−39.7	....	2	....	....	
....	28000	....	−40.1	....	2	....	....	
....	29000	....	−40.5	....	2	....	....	
....	30000	....	−40.8	....	2	....	....	
6 33.2	30486	9.8	−41.0	0.0	2	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909-March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 2, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 58.5	392	724.8	19.6	....	70	N. 22° W.	6.3	
....	500	....	18.2	....	73	N. 24° W.	6.6	
5 02.5	882	684.1	14.0	1.1	84	N. 30° W.	7.9	10/10 St.-Cu. NNW.
....	1000	....	13.1	....	85	N. 31° W.	7.8	
....	1500	....	9.0	....	89	N. 36° W.	7.5	Inversion.
5 06.6	1539	632.2	9.3	0.7	89	N. 36° W.	7.5	Balloon in St.-Cu. at 5:06 p. m.
5 08.6	1926	603.4	12.3	−0.8	46	....	....	
....	2000	....	11.8	....	44	....	....	
5 11.1	2350	573.5	9.5	0.7	34	....	....	
....	2500	....	7.7	....	36	....	....	
5 13.9	2853	539.0	3.5	1.2	40	....	....	
....	3000	....	2.8	....	38	....	....	
5 18.2	3481	498.6	0.9	0.4	33	....	....	
....	3500	....	0.8	....	33	....	....	
....	4000	....	− 3.7	....	37	....	....	
5 22.9	4266	451.5	− 6.6	1.0	39	....	....	
....	4500	....	− 8.0	....	46	....	....	
5 26.8	4880	417.3	−10.3	0.6	53	....	....	
....	5000	....	−10.5	....	45	....	....	
5 27.7	5017	410.1	−10.5	0.1	44	....	....	
....	6000	....	−16.9	....	32	....	....	
5 33.7	6144	353.2	−17.8	0.6	30	....	....	
....	7000	....	−24.7	....	30	....	....	
5 40.3	7222	305.5	−26.5	0.8	30	....	....	
5 41.3	7354	299.9	−26.8	0.2	33	....	....	
....	8000	....	−31.8	....	36	....	....	
5 50.0	8900	241.1	−38.7	0.8	40	....	....	
....	9000	....	−39.5	....	40	....	....	
5 54.2	9682	215.5	−45.0	0.8	37	....	....	
....	10000	....	−47.4	....	37	....	....	
5 58.5	10524	190.1	−51.2	0.7	36	....	....	
6 00.9	11026	175.8	−52.4	0.2	34	....	....	Inversion.
6 05.1	11940	153.4	−50.7	−0.2	33	....	....	
....	12000	....	−50.9	....	33	....	.....	
....	13000	....	−53.6	....	32	....	....	
6 11.1	13639	118.1	−55.3	0.3	32	....	....	
....	14000	....	−55.7	....	....	....	....	
6 15.1	14990	93.4	−56.6	0.1	....	....	....	Inversion.
....	16000	....	−55.0	....	....	....	....	
6 18.5	16276	78.6	−54.5	−0.2	....	....	....	
....	17000	....	−55.2	....	....	....	....	
6 21.8	17539	64.5	−55.7	0.1	....	....	....	Inversion.
....	18000	....	−54.7	....	....	....	....	
6 28.2	18978	51.7	−52.6	−0.2	....	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 3, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
5 02.5	392	721.7	22.0	....	57	S. 8° E.	4.5	
....	500	....	20.8	....	60	S. 8° E.	5.0	
....	1000	....	15.5	....	74	S. 8° E.	7.1	
5 05.4	1075	666.2	14.7	1.1	76	S. 8° E.	7.4	10/10 St.-Cu. W.
....	1500	....	10.2	....	92	S. 2° W.	6.8	
5 08.5	1705	617.7	8.0	1.1	100	S. 7° W.	6.6	Inversion.
5 09.3	1812	609.7	8.4	−0.4	100	S. 28° W.	6.2	Balloon in clouds from 5:16.5 to 5:19 p. m.
....	2000	....	7.5	....	96	S. 43° W.	5.6	
5 11.0	2067	590.9	7.0	0.5	94	S. 47° W.	5.4	
....	2500	....	4.5	....	99	S. 61° W.	7.8	
5 14.0	2559	556.4	4.1	0.6	100	S. 62° W.	8.1	Balloon in St.-Cu. 5:19.5 p.m
....	3000	....	1.0	....	100	....	....	
....	3500	....	− 3.0	....	100	....	....	
5 20.6	3763	478.5	− 4.8	0.7	100	....	....	
....	4000	....	− 5.8	....	82	....	....	
5 22.8	4137	456.4	− 6.3	0.4	71	....	....	
....	4500	....	− 8.8	....	60	....	....	
....	5000	....	−11.9	....	41	....	....	
5 27.7	5160	399.7	−13.0	0.7	36	....	....	
5 28.8	5338	390.7	−13.5	0.3	33	....	....	
....	6000	....	−17.9	....	44	....	....	
5 34.2	6481	335.2	−20.8	0.6	54	....	....	
....	7000	....	−24.4	....	64	....	....	
5 40.4	7922	275.3	−30.5	0.7	79	....	....	
....	8000	....	−31.1	....	79	....	....	
5 44.5	8772	243.9	−36.7	0.7	78	....	....	
....	9000	....	−38.5	....	75	....	....	
....	10000	....	−46.2	....	64	....	....	
5 49.2	10552	187.9	−50.6	0.8	57	....	....	
....	11000	....	−51.7	....	54	....	....	
5 52.1	11597	160.5	−53.2	0.2	51	....	....	
....	12000	....	−54.0	....	48	....	....	
5 56.0	12628	136.8	−55.3	0.2	43	....	....	
....	13000	....	−57.1	....	41	....	....	
5 58.9	13722	115.6	−60.3	0.5	39	....	....	
....	14000	....	−60.9	....	39	....	....	
6 02.2	14556	101.1	−62.2	0.2	39	....	....	
....	15000	....	−63.3	....	39	....	....	
6 04.2	15478	87.3	−64.2	0.2	39	....	....	Inversion.
....	16000	....	−63.2	....	38	....	....	
6 07.7	16446	74.9	−62.3	−0.2	37	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 4, 1910.

Time.	Altitude.	Pressure.	Temperature.	Δ t 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
4 54.8	392	718.2	20.1	....	86	S. 45° E.	8.5	
....	500	....	19.9	....	82	S. 47° E.	7.3	
4 57.6	983	670.3	18.8	0.2	63	S. 56° E.	1.4	
....	1000	....	18.7	....	63	....	....	
....	1500	....	15.5	....	57	S. 49° E.	3.6	
5 02.0	1979	594.9	12.5	0.6	52	S. 42° E.	5.8	
....	2000	....	12.3	....	54	S. 35° W.	5.8	
....	2500	....	7.4	....	62	S. 35° W.	5.6	
5 05.7	2761	541.7	4.8	1.0	66	S. 35° W.	5.5	
....	3000	....	3.3	....	67	S. 46° W.	8.5	
5 07.5	3207	512.9	1.9	0.7	67	S. 53° W.	10.3	
....	3500	....	− 0.9	....	74	S. 85° W.	10.5	
5 10.5	3795	476.4	− 3.9	1.0	82	S. 85° W.	10.8	
....	4000	....	− 5.3	....	80	S. 83° W.	10.6	
....	4500	....	− 8.6	....	76	S. 77° W.	10.2	
5 14.4	4590	430.3	− 9.2	0.7	75	S. 76° W.	10.1	
5 16.0	4834	417.0	−10.0	0.3	68	N. 73° W.	16.0	
....	5000	....	−11.1	....	68	N. 74° W.	15.5	
5 21.8	5992	358.0	−18.2	0.7	66	S. 80° W.	12.4	
5 26.4	6906	316.4	−24.4	0.7	51	S. 78° W.	13.8	
....	7000	....	−25.1	....	51	S. 76° W.	14.5	
5 30.1	7561	289.0	−29.2	0.7	51	S. 64° W.	17.3	
....	8000	....	−33.0	....	51	S. 60° W.	17.9	1/10 Ci.-St. WSW. Few St.-Cu. W.
5 34.7	8509	253.0	−37.2	0.8	50	S. 56° W.	18.6	
....	9000	....	−41.8	....	49	S. 53° W.	17.5	
5 39.4	9372	222.9	−45.4	1.0	48	S. 51° W.	16.7	Inversion.
5 41.0	9792	209.7	−45.2	0.0	47	S. 46° W.	27.9	
....	10000	....	−45.8	....	47	S. 45° W.	28.6	
5 44.2	10454	189.9	−47.2	0.3	47	S. 42° W.	30.1	
....	11000	....	−48.5	....	47	S. 47° W.	35.6	
5 48.7	11730	157.1	−50.3	0.2	46	S. 53° W.	42.8	
5 49.8	12013	150.5	−50.2	0.0	46	S. 56° W.	48.5	
5 52.2	12706	135.4	−51.5	0.2	46	S. 56° W.	41.7	Inversion.
....	13000	....	−51.1	....	46	S. 58° W.	37.6	
5 54.2	13188	125.9	−50.8	−0.1	46	S. 59° W.	35.2	
....	14000	....	−51.0	....	46	S. 57° W.	37.7	
5 57.8	14342	105.6	−51.1	0.0	46	S. 56° W.	38.7	
....	15000	....	−51.7	....	46	S. 59° W.	35.4	
....	15879	83.5	−52.4	0.1	....	S. 63° W.	21.8	Inversion.
....	16000	....	−52.0	....	....	S. 64° W.	18.8	
6 03.8	16541	75.6	−50.9	−0.2	....	S. 70° W.	4.9	
....	17000	....	−50.4	....	....	S. 66° W.	6.9	
6 08.0	17827	62.0	−49.6	−0.1	....	S. 59° W.	7.8	
....	18000	....	−49.5	....	....	S. 59° W.	8.1	
....	19000	....	−49.1	....	....	S. 50° W.	9.6	
6 12.4	19461	48.4	−49.0	0.0	....	S. 59° W.	10.3	
....	20000	....	−47.9	....	....	S. 71° W.	5.3	
6 16.1	20412	41.9	−47.1	−0.2	....	S. 81° W.	1.4	
....	21000	....	−47.1	....	....	S. 76° W.	3.4	
....	22000	....	−46.9	....	....	S. 68° W.	6.8	
6 21.4	22413	31.1	−46.8	0.0	....	S. 64° W.	8.2	
....	23000	....	−45.6	....	....	S. 66° W.	7.1	
....	24000	....	−43.8	....	....	S. 70° W.	5.3	
6 28.9	24766	21.8	−42.3	−0.2	....	S. 73° W.	3.9	Few Ci. 2/10 Ci.-Cu. WSW.
....	25000	....	−41.7	....	....	S. 74° W.	3.6	
....	26000	....	−39.4	....	....	S. 77° W.	2.2	
6 36.7	**26806**	16.2	−37.6	−0.2	....	S. 80° W.	1.1	Balloon burst 6:38 p. m.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 5, 1910.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
a. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
11 07.8	392	719.4	19.9		56	W.	7.6	
	500		18.9			S. 89° W.	8.3	
	1000		14.1			S. 84° W.	11.8	
	1500		9.4			S. 79° W.	15.3	
11 12.8	1695	615.9	7.6	0.9		S. 77° W.	16.7	Base of St.-Cu.
11 13.8	1883	601.9	7.1	0.3		S. 77° W.	12.8	
	2000		6.2					
11 16.4	2445	561.8	2.9	0.7				Balloon in St.-Cu. at 11:15.5 a. m.
	2500		2.8					
	3000		2.2					
11 20.6	3414	498.3	1.8	0.1				Pressure record from 11:30.3 to 11:59.5 was partially effaced when found. The intervening levels were computed from the rate of ascent.
	3500		1.4					
	4000		− 1.0					
11 24.4	4108	456.8	− 1.5	0.5				
	4500		− 4.2					
	5000		− 7.4					
11 30.3	5525	381.1	−10.9	0.7				
	6000		−14.1					
11 35.7	6548		−17.4	0.6				
	7000		−21.3					
11 40.1	7383		−24.6	0.9				
	8000		−30.5					
11 44.3	8179		−32.3	1.0				
	9000		−32.9					
	10000		−33.7					
11 54.8	10170		−33.8	0.1				
	11000		−35.9					
11 59.5	**11068**	179.0	**−36.0**	0.2				

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd

THIRD SERIES, HURON—Continued.

SEPTEMBER 5, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
5 06.7	392	721.0	20.4	......	49	N. 68° W.	10.7	
......	500	......	19.4	......	52	N. 68° W.	11.7	
......	1000	......	14.6	......	66	N. 66° W.	17.0	
5 12.0	1291	648.3	12.0	0.9	74	N. 65° W.	20.1	5/10 St.-Cu. WNW.
......	1500	......	10.2	......	79	N. 65° W.	20.1	
......	2000	......	6.0	......	91	N. 65° W.	20.0	
5 17.8	2389	567.2	2.5	0.9	100	N. 65° W.	20.0	Balloon in St.-Cu. at 5:15 p. m.
5 18.8	2500	559.5	3.1	......	93	......	......	
5 21.1	2969	527.7	0.8	0.5	86	......	......	Inversion.
......	3000	......	0.9	......	83	......	......	
5 21.8	3155	515.6	1.3	−0.3	67	......	......	
......	3500	......	− 0.5	......	63	......	......	
......	4000	......	− 3.3	......	57	......	......	
5 27.6	4357	443.3	− 5.2	0.5	52	......	......	
......	4500	......	− 6.0	......	51	......	......	
......	5000	......	− 8.9	......	48	......	......	
5 33.1	5495	382.7	−11.9	0.6	45	......	......	
......	6000	......	−15.4	......	41	......	......	
5 38.7	6674	327.5	−20.2	0.7	37	......	......	
......	7000	......	−22.6	......	32	......	......	
5 44.2	7840	279.1	−28.7	0.7	25	......	......	
......	8000	......	−29.8	......	25	......	......	
......	9000	......	−37.4	......	28	......	......	
5 49.2	9012	236.9	−37.5	0.8	28	......	......	
......	10000	......	−44.6	......	28	......	......	
5 54.4	10047	203.5	−44.7	0.7	28	......	......	Inversion.
5 55.1	10369	194.3	−43.7	−0.3	28	......	......	
......	11000	......	−46.7	......	25	......	......	
5 58.0	11109	174.2	−47.2	0.5	24	......	......	Inversion.
6 01.0	11906	154.7	−44.2	−0.4	23	......	......	
......	12000	......	−43.9	......	23	......	......	
......	13000	......	−46.9	......	21	......	......	
......	14000	......	−49.9	......	20	......	......	
6 08.6	14491	105.1	−51.4	0.3	19	......	......	
......	15000	......	−51.6	......	17	......	......	
6 11.1	15157	94.9	−51.6	0.0	17	......	......	
6 12.1	15640	88.2	−55.0	0.7	17	......	......	
......	16000	......	−55.3	......	17	......	......	
......	17000	......	−56.1	......	17	......	......	
6 17.5	17785	63.2	−56.7	0.1	17	......	......	Inversion.
......	18000	......	−55.4	......	17	......	......	
6 18.8	18181	59.3	−54.1	−0.7	17	......	......	
......	19000	......	−52.2	......	17	......	......	
6 23.2	19782	46.5	−50.3	−0.2	17	......	......	
......	20000	......	−50.1	......	17	......	......	
......	21000	......	−51.0	......	16	......	......	
6 26.6	21092	38.0	−51.1	0.1	16	......	......	Inversion.
......	22000	......	−49.3	......	16	......	......	
......	23000	......	−46.8	......	16	......	......	
......	24000	......	−44.3	......	16	......	......	
6 35.6	24198	23.8	−43.9	−0.2	16	......	......	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 6, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
6 28.0	392	720.7	28.5	....	32	S.	12.5	
....	500	....	27.9	....	32	S.	13.4	
....	1000	....	25.2	....	30	S.	17.9	
6 32.8	1201	657.1	23.9	0.6	30	S.	19.7	
....	1500	....	20.6	....	32	....	....	Cloudless.
....	2000	....	15.0	....	35	....	....	
6 37.6	2016	597.5	14.8	1.1	35	....	....	Balloon disappeared behind buildings at 6:34 p. m.
....	2500	....	10.3	....	40	....	....	
6 43.1	2837	541.3	7.0	0.9	44	....	....	Inversion.
....	3000	....	7.3	....	37	....	....	
6 43.8	3018	529.5	7.3	−0.2	36	....	....	
....	3500	....	3.4	....	30	....	....	
6 49.6	3914	474.0	0.1	0.8	25	....	....	
....	4000	....	− 0.5	....	25	....	....	
....	4500	....	− 4.2	....	23	....	....	
6 55.7	4912	417.9	− 7.1	0.7	22	....	....	
....	5000	....	− 7.9	....	22	....	....	
6 59.5	5543	385.2	−13.0	0.9	21	....	....	
....	6000	....	−16.9	....	21	....	....	
7 03.8	6151	355.3	−18.3	0.9	21	....	....	
....	7000	....	−23.0	....	20	....	....	
7 08.9	7063	314.3	−23.3	0.5	20	....	....	
....	8000	....	−30.0	....	18	....	....	
7 14.6	8079	273.3	−30.6	0.7	18	....	....	
....	9000	....	−37.3	....	18	....	....	
7 21.2	9020	239.5	−37.4	0.7	18	....	....	
....	10000	....	−42.2	....	18	....	....	
7 26.0	10071	205.7	−42.6	0.5	18	....	....	
7 31.0	10924	181.6	−46.0	0.4	18	....	....	
....	11000	....	−46.3	....	18	....	....	
7 36.1	11864	157.8	−48.6	0.3	18	....	....	Inversion.
....	12000	....	−48.8	....	18	....	....	
7 40.2	12633	140.8	−48.6	0.0	18	....	....	
....	13000	....	−48.7	....	18	....	....	
7 44.9	13546	22.8	−48.8	0.0	18	....	....	
....	14000	....	−49.6	....	18	....	....	
7 48.5	14551	105.5	−50.4	0.2	18	....	....	
....	15000	....	−51.3	....	17	....	....	
7 51.2	15366	93.0	−52.0	0.2	17	....	....	
....	16000	....	−52.6	....	17	....	....	
7 54.9	16408	79.5	−53.0	0.1	17	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 7, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 40.2	392	724.3	25.2	....	46	N.	7.6	
....	500	....	24.2	....	50	N.	7.8	Few A.-Cu. WSW.
....	1000	....	19.6	....	58	N. 20° W.	8.0	
4 44.8	1143	664.0	18.3	0.9	61	N. 23° W.	8.1	
....	1500	....	16.7	....	60	N. 2° W.	7.3	
4 48.1	1749	618.3	15.7	0.4	59	S. 14° W.	6.5	Inversion.
....	2000	....	18.5	....	35	S. 30° W.	8.0	
4 50.2	2062	596.0	19.2	−1.1	25	S. 35° W.	8.6	
....	2500	....	15.5	....	23	S. 45° W.	9.2	
....	3000	....	11.2	....	20	S. 60° W.	10.5	
4 56.5	3237	518.4	9.2	0.8	17	S. 69° W.	11.1	
....	3500	....	6.6	....	20	S. 65° W.	11.5	
....	4000	....	1.8	....	22	S. 60° W.	13.0	
5 03.7	4484	444.3	− 2.9	1.0	24	S. 56° W.	13.8	
....	4500	....	− 3.0	....	25	S. 56° W.	14.0	
....	5000	....	− 7.2	....	30	S. 60° W.	15.5	
5 10.2	5757	377.4	−13.4	0.8	36	S. 66° W.	17.8	Inversion.
5 11.2	5966	367.2	−13.0	−0.2	30	S. 76° W.	12.2	
....	6000	....	−13.2	....	29	S. 75° W.	13.0	
....	7000	....	−20.2	....	24	S. 73° W.	17.0	
5 17.1	7276	308.6	−22.1	0.7	22	S. 72° W.	17.8	
....	8000	....	−27.0	....	21	S. 72° W.	16.8	
5 23.0	8513	260.5	−30.4	0.7	20	S. 71° W.	16.1	
....	9000	....	−34.0	....	20	S. 74° W.	16.5	
....	10000	....	−41.4	....	19	S. 80° W.	18.2	
5 31.2	10507	195.8	−45.2	0.7	19	S. 83° W.	19.1	
....	11000	....	−47.8	....	19	S. 84° W.	18.8	
5 37.0	11847	160.6	−52.4	0.5	19	S. 85° W.	18.0	Inversion.
....	12000	....	−52.1	....	19	S. 80° W.	25.0	
5 38.6	12243	151.2	−51.6	−0.2	19	S. 74° W.	32.5	
....	13000	....	−52.0	....	19	S. 70° W.	36.5	
5 42.9	13444	125.7	−52.2	0.0	19	S. 68° W.	39.2	
....	14000	....	−54.4	....	19	S. 67° W.	34.5	
5 47.2	14452	107.8	−56.2	0.4	19	S. 67° W.	31.2	
....	15000	....	−57.3	....	19	S. 69° W.	33.0	
5 50.9	15764	88.0	−58.8	0.2	19	S. 70° W.	34.5	Inversion.
....	16000	....	−58.2	....	19	S. 63° W.	35.5	
5 51.9	16192	82.4	−57.7	−0.3	19	S. 58° W.	36.3	Few A.-Cu. WSW.
....	17000	....	−58.0	....	19	S. 60° W.	15.0	Inversion.
5 54.8	17227	70.0	−58.1	0.0	19	S. 60° W.	6.8	Balloon disappeared at 6:04 p. m.
....	18000	....	−54.2	....	19	....	....	Meteorograph clock stopped at 6 p. m., but started again when balloon burst.
....	19000	....	−49.2	....	19	....	....	
....	19859	50.4	−47.4	−0.5	19	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909-March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 8 1910.

Time.	Altitude.	Pressure.	Temperature.	Δt 100 m.	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
a. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 44.2	392	738.3	15.8	....	37	N.	7.6	
....	500	....	14.0	....	39	N. 4° W.	7.3	
4 46.8	733	709.4	10.1	1.7	42	N. 14° W.	6.6	
....	1000	....	7.4	....	44	N. 15° W.	7.3	
....	1500	....	2.5	....	52	N. 18° W.	8.2	
4 51.9	1516	644.6	2.3	1.0	52	N. 18° W.	8.2	Inversion.
4 53.7	1812	621.4	5.1	−0.9	42	N. 33° W.	7.5	
....	2000	....	4.7	....	38	N. 32° W.	9.4	
4 55.9	2234	590.0	4.3	0.2	34	N. 31° W.	11.4	
....	2500	....	3.0	....	39	N. 43° W.	10.4	
4 59.6	2925	541.6	1.0	0.5	45	N. 58° W.	9.0	Inversion.
....	3000	....	1.6	....	44	N. 56° W.	10.1	
5 01.1	3198	523.4	3.3	−0.8	42	N. 53° W.	12.4	
....	3500	....	1.3	....	41	N. 66° W.	13.6	
5 05.3	3908	479.0	− 1.4	0.7	40	N. 83° W.	15.3	
....	4000	....	− 2.2	....	40	N. 83° W.	15.8	
....	4500	....	− 6.7	....	43	N. 84° W.	18.4	
5 10.8	4927	420.6	−10.6	0.9	45	N. 84° W.	20.4	1 Ci.-St. WSW. 2 A.-St. WSW.
....	5000	....	−11.2	....	45	N. 83° W.	20.4	
....	6000	....	−19.0	....	47	N. 77° W.	20.8	
5 16.9	6142	358.3	−20.1	0.8	47	N. 76° W.	20.8	
....	7000	....	−26.0	....	45	N. 76° W.	25.1	
5 24.1	7517	296.7	−29.5	0.7	42	N. 76° W.	27.5	Balloon in Ci.-St. at 5:24 p. m.
....	8000	....	−33.0	....	42	....	....	
5 30.3	8674	251.9	−38.2	0.8	42	....	....	
....	9000	....	−40.6	....	42	....	....	
5 35.3	9562	221.1	−45.0	0.8	41	....	....	
....	10000	....	−47.7	....	40	....	....	
5 41.4	10848	182.6	−52.8	0.6	39	....	....	
....	11000	....	−53.1	....	....	....	....	
....	12000	....	−55.3	....	....	....	....	
5 46.8	12556	140.5	−56.5	0.2	....	....	....	
....	13000	....	−57.0	....	....	....	....	
....	14000	....	−58.2	....	....	....	....	
....	15000	....	−59.4	....	....	....	....	
5 56.2	15115	94.1	−59.5	0.1	....	....	....	Inversion.
....	16000	....	−59.0	....	....	....	....	
....	17000	....	−58.3	....	....	....	....	
6 03.0	17221	67.5	−58.2	−0.1	....	....	....	
6 04.8	17746	62.3	−56.5	−0.3	....	....	....	
6 05.8	17945	60.2	−57.3	0.4	....	....	....	
....	18000	....	−57.0	....	....	....	....	
6 09.1	18683	53.7	−52.8	−0.6	....	....	....	
....	19000	....	−52.5	....	....	....	....	
....	20000	....	−51.5	....	....	....	....	
6 15.3	20817	41.8	−51.2	−0.1	35	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 9, 1910.

Time.	Altitude.	Pressure.	Temperature.	Δ *t* 100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*	°	*m. p. s.*	
4 45.2	392	734.6	19.8	....	35	S.	2.8	Cloudless.
....	500	....	18.4	....	36	S.	3.1	
....	1000	....	11.8	....	42	S. 3° E.	4.8	
4 50.8	1107	674.9	10.4	1.3	43	S. 3° E.	5.1	
....	1500	....	6.6	....	50	S. 10° W.	4.0	
4 56.4	1725	625.9	4.4	1.0	53	S. 16° W.	3.4	Inversion.
4 57.6	1838	617.2	5.4	−0.9	64	N. 55° W.	1.2	
....	2000	....	4.4	....	66	N. 57° W.	3.2	
5 00.0	2174	....	3.4	....	69	N. 59° W.	5.3	
....	2500	....	1.5	....	72	N. 84° W.	7.6	
5 02.5	2522	567.2	1.4	0.6	72	N. 86° W.	7.7	Inversion.
5 04.3	2818	546.7	5.1	−1.2	53	N. 81° W.	9.0	
....	3000	....	3.5	....	50	N. 70° W.	8.6	
5 06.7	3197	521.7	1.9	0.8	48	N. 59° W.	8.1	
5 08.5	3440	506.1	1.6	0.1	35	N. 57° W.	8.8	
....	3500	....	1.2	....	34	N. 57° W.	9.0	
....	4000	....	− 2.6	....	29	N. 58° W.	10.0	
....	4500	....	− 6.3	....	24	N. 60° W.	11.0	
5 16.5	4697	431.8	− 7.7	0.7	22	N. 60° W.	11.4	
....	5000	....	− 9.9	....	21	N. 60° W.	12.0	
....	6000	....	−17.1	....	20	N. 61° W.	13.9	
5 27.9	6492	340.8	−20.7	0.7	19	N. 61° W.	14.4	
....	7000	....	−24.5	....	19	N. 60° W.	16.5	
5 34.2	7716	288.3	−29.8	0.7	19	N. 63° W.	19.4	
....	8000	....	−31.0	....	19	N. 62° W.	20.2	
....	9000	....	−35.5	....	20	N. 59° W.	22.9	
5 40.3	9475	224.6	−37.6	0.4	20	N. 57° W.	24.2	
....	10000	....	−38.7	....	....	N. 48° W.	24.4	
5 43.1	10170	203.2	−39.0	0.2	....	N. 44° W.	24.5	Cloudless,
....	11000	....	−41.9	....	....	N. 51° W.	35.4	
5 46.5	11149	176.3	−42.4	0.3	....	N. 52° W.	36.8	Balloon disappeared at 5:48.3 p. m.
....	12000	....	−43.3	....	....	....	....	
5 51.9	12649	141.5	−44.0	0.1	....	....	....	
....	13000	....	−44.1	....	....	....	....	
5 54.9	13382	127.9	−44.2	0.0	....	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 10, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 47.3	392	719.4	24.6	....	42	S. 22° E.	9.4	
....	500	....	23.7	....	43	S. 21° E.	9.8	
....	1000	....	19.5	....	46	S. 14° E.	11.7	
4 55.0	1417	638.4	16.0	0.9	49	S. 9° E.	13.3	6/10 Ci.-St. W. 3/10 A.-St. W.
....	1500	....	15.3	....	50	S. 34° W.	13.6	
....	2000	....	11.9	....	56	S. 34° W.	15.3	
5 00.1	2342	571.6	9.5	0.7	60	S. 34° W.	16.4	Inversion.
....	2500	....	11.4	....	50	S. 81° W.	14.1	
5 02.1	2642	551.5	13.1	−1.2	40	S. 81° W.	11.8	
....	3000	....	10.7	....	36	S. 86° W.	12.6	
....	3500	....	6.5	....	31	N. 88° W.	13.5	
5 07.9	3740	482.6	4.9	0.7	28	N. 86° W.	13.9	
....	4000	....	3.2	....	27	N. 87° W.	13.6	
....	4500	....	− 1.5	....	26	N. 89° W.	13.3	
5 13.4	4674	429.8	− 2.9	0.8	25	W.	13.1	
....	5000	....	− 5.5	....	25	S. 87° W.	13.0	
5 18.9	5698	377.0	−11.8	0.9	25	S. 80° W.	12.7	
....	6000	....	−14.2	....	26	S. 82° W.	13.3	
5 23.6	6566	336.2	−18.6	0.8	29	S. 85° W.	14.6	Inversion.
5 24.6	6740	328.3	−16.9	−1.0	26	S. 85° W.	18.7	
....	7000	....	−19.4	....	25	S. 85° W.	18.7	
5 29.5	7790	285.2	−24.1	0.7	23	S. 84° W.	18.5	
....	8000	....	−25.5	....	23	....	....	
5 34.8	8915	244.3	−31.6	0.7	25	....	....	Balloon in Ci.-St. at 5:30.5 p. m.
....	9000	....	−32.2	....	25	....	....	
....	10000	....	−39.5	....	25	....	....	
5 41.3	10294	200.7	−41.5	0.7	25	....	....	
....	11000	....	−46.1	....	25	....	....	
5 46.0	11259	173.9	−47.9	0.7	25	....	....	
....	12000	....	−51.5	....	25	....	....	
5 51.1	12804	138.0	−54.7	0.4	25	....	....	Inversion.
....	13000	....	−53.5	....	25	....	....	
5 54.4	13646	121.3	−50.0	−0.6	25	....	....	
....	14000	....	−50.0	....	25	....	....	
....	15000	....	−50.1	....	23	....	....	
5 58.7	15278	94.7	−50.1	0.0	23	....	....	
....	16000	....	−51.6	....	23	....	....	
6 03.1	16743	75.7	−53.1	0.2	22	....	....	
....	17000	....	−52.4	....	22	....	....	
6 04.9	17533	67.2	−51.1	−0.3	23	....	....	
....	18000	....	−51.3	....	22	....	....	
6 07.9	18534	57.7	−51.6	0.0	22	....	....	
....	19000	....	−50.1	....	22	....	....	
....	20000	....	−47.2	....	23	....	....	
6 13.6	20328	44.0	−46.3	−0.3	23	....	....	
....	21000	....	−44.9	....	23	....	....	
....	22000	....	−43.5	....	22	....	....	
6 20.3	22680	31.2	−42.3	−0.2	22	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 11, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
a. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
7 14.8	392	723.3	14.3	....	44	N. 22° E.	10.3	
....	500	....	13.3	....	45	N. 22° E.	11.5	
7 17.7	976	674.3	9.0	0.9	50	N. 23° E.	17.6	10/10 St. NNE.
....	1000	....	9.0	....	52	....	....	
....	1500	....	8.7	....	82	....	....	
7 22.5	1813	609.4	8.6	0.0	100	....	....	Inversion. Balloon in St. at 7:21.5 a. m.
....	2000	....	13.9	....	63	....	....	
7 24.0	2054	592.0	15.4	−2.8	52	....	....	
....	2500	....	11.8	....	49	....	....	
....	3000	....	8.1	....	45	....	....	
....	3500	....	4.4	....	42	....	....	
7 31.2	3586	492.0	3.7	0.8	41	....	....	
....	4000	....	0.0	....	47	....	....	
....	4500	....	− 4.2	....	54	....	....	
....	5000	....	− 8.3	....	62	....	....	
7 38.0	5146	404.0	− 9.6	0.9	64	....	....	
....	6000	....	−13.3	....	83	....	....	
7 42.8	6209	351.9	−14.1	0.4	88	....	....	
....	7000	....	−18.9	....	91	....	....	
7 48.7	7778	285.2	−24.0	0.6	94	....	....	
....	8000	....	−25.4	....	93	....	....	
....	9000	....	−32.7	....	89	....	....	
7 54.6	9312	230.6	−34.9	0.7	88	....	....	
....	10000	....	−40.6	....	87	....	....	
7 59.4	10071	206.5	−41.2	0.8	87	....	....	
....	11000	....	−46.9	....	85	....	....	
8 05.7	11458	168.2	−49.6	0.6	84	....	....	
....	12000	....	−52.0	....	84	....	....	
....	13000	....	−56.4	....	84	....	....	
8 11.4	13048	132.1	−56.7	0.4	84	....	....	Inversion.
....	14000	....	−53.4	....	84	....	....	
8 15.8	14154	111.6	−52.8	−0.4	84	....	....	
....	15000	....	−51.4	....	81	....	....	
8 20.6	15842	86.3	−50.1	−0.2	77	....	....	
....	16000	....	−50.4	....	75	....	....	
....	17000	....	−52.1	....	73	....	....	Inversion.
8 24.2	17030	72.0	−52.0	0.2	73	....	....	
....	18000	....	−49.0	....	72	....	....	
8 27.7	18473	57.8	−47.6	−0.3	71	....	....	
....	19000	....	−47.1	....	70	....	....	
....	20000	....	−46.1	....	69	....	....	
8 32.4	20633	41.8	−45.5	−0.1	68	....	....	
....	21000	....	−44.4	....	67	....	....	
....	22000	....	−41.0	....	65	....	....	
8 36.5	22345	32.5	−40.0	−0.3	64	....	....	
....	23000	....	−36.0	....	62	....	....	
8 39.9	23259	....	−34.5	−0.6	62	....	....	Pressure pen not recording. Altitude computed from ascensional rate.
....	24000	....	−27.6	....	62	....	....	
8 42.7	24012	....	−27.5	−0.9	62	....	....	
8 46.0	24899	....	−25.5	−0.2	56	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 11, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
4 59.5	392	730.6	13.2	....	53	N.	8.5	
....	500	....	12.0	....	55	N. 2° E.	8.9	
5 04.6	961	682.1	7.1	1.1	62	N. 11° E.	10.5	5/10 Ci.-St. WSW. 4/10 A.-St. WSW.
....	1000	....	7.6	....	60	N. 17° E.	11.7	
5 05.5	1079	672.4	8.5	−1.2	55	N. 28° E.	14.3	
....	1500	....	5.9	....	54	N. 33° E.	13.7	
....	2000	....	2.8	....	52	N. 39° E.	13.0	
5 12.4	2012	599.8	2.7	0.6	52	N. 39° E.	13.0	
....	2500	....	1.1	....	70	N. 16° E.	8.4	
5 16.7	2562	560.2	0.9	0.3	72	N. 14° E.	7.9	Inversion.
5 20.2	3006	530.1	2.7	−0.4	56	N. 35° W.	8.4	
....	3500	....	0.2	....	60	N. 72° W.	10.3	
5 26.2	3746	483.3	− 0.9	0.5	62	S. 89° W.	11.2	Balloon in A. St. at 5:29.5 p. m.
....	4000	....	− 2.1	....	75	....	....	
....	4500	....	− 4.6	....	96	....	....	
5 32.6	4627	432.7	− 5.1	0.5	100	....	....	
....	5000	....	− 7.4	....	92	....	....	
5 39.6	5599	381.7	−11.6	0.7	80	....	....	9/10 A. St. WSW.
....	6000	....	−14.4	....	77	....	....	
5 43.9	6202	352.5	−15.7	0.7	76	....	....	
5 49.3	6979	317.9	−19.1	0.4	88	....	....	
....	7000	....	−19.2	....	88	....	....	
....	8000	....	−25.0	....	84	....	....	
6 00.0	8467	259.6	−27.7	0.6	82	....	....	
....	9000	....	−31.3	....	77	....	....	
6 07.9	9728	217.6	−36.3	0.7	70	....	....	
....	10000	....	−38.8	....	70	....	....	
6 14.5	10924	182.6	−48.9	1.1	68	....	....	
....	11000	....	−49.8	....	68	....	....	
....	12000	....	−62.0	....	67	....	....	
6 22.0	12107	152.2	−63.3	1.2	67	....	....	
....	13000	....	−67.9	....	66	....	....	
6 28.7	13207	127.7	−68.9	0.5	66	....	....	Inversion.
6 31.2	13624	119.5	−63.8	−1.2	66	....	....	
6 32.6	13915	113.9	−65.1	0.4	65	....	....	
....	14000	....	−63.7	....	65	....	....	
6 34.3	14125	110.2	−61.6	−1.7	64	....	....	
6 39.5	15032	95.3	−62.2	0.1	62	....	....	
6 42.4	15603	87.2	−58.4	−0.7	60	....	....	
....	16000	....	−61.6	....	59	....	....	
6 46.1	16302	78.1	−64.0	0.8	58	....	....	Inversion.
....	17000	....	−60.5	....	57	....	....	
6 54.4	17508	64.5	−58.0	−0.5	57	....	....	
....	18000	....	−57.0	....	56	....	....	
....	19000	....	−55.1	....	55	....	....	
7 11.8	19267	48.9	−54.6	−0.2	55	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 13, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 51.3	392	737.6	17.8	....	33	S. 45° E.	0.9	
....	500	....	16.7	....	34	S. 40° E.	1.2	
....	1000	....	11.5	....	38	S. 20° W.	2.7	
4 56.8	1467	684.4	6.6	1.0	42	N. 80° W.	4.1	5/10 Ci.-St. WNW. 5/10 A.-St. WNW.
....	1500	....	6.5	....	43	N. 77° W.	4.2	
4 59.1	1924	613.1	4.7	0.4	52	N. 45° W.	5.8	
....	2000	....	4.1	....	53	N. 47° W.	5.8	
5 01.0	2306	584.8	1.7	0.8	61	N. 75° W.	5.3	Inversion.
....	2500	....	2.1	....	63	N. 76° W.	6.9	
5 03.7	2803	549.9	2.6	−0.2	65	N. 77° W.	9.3	
....	3000	....	1.3	....	64	N. 74° W.	9.6	
....	3500	....	− 1.9	....	63	N. 69° W.	10.2	
5 07.7	3555	500.5	− 2.3	0.7	63	N. 68° W.	10.3	
....	4000	....	− 5.4	....	65	N. 70° W.	11.0	
5 12.1	4325	453.9	− 7.5	0.7	67	N. 71° W.	11.5	
....	4500	....	− 8.5	....	67	N. 71° W.	11.9	
....	5000	....	−11.3	....	68	N. 72° W.	13.0	
5 16.4	5085	411.4	−11.7	0.6	68	N. 72° W.	13.2	
5 18.4	5391	395.3	−11.7	0.0	70	N. 75° W.	18.5	Balloon in A.-St. at 5:22 p. m.
....	6000	....	−15.8	....	75	....	....	
5 23.9	6378	346.9	−18.3	0.7	78	....	....	
....	7000	....	−21.7	....	79	....	....	
5 29.1	7302	306.3	−23.7	0.6	80	....	....	10/10 A.-St. WNW.
....	8000	....	−28.5	....	78	....	....	
5 34.6	8396	263.2	−31.2	0.7	77	....	....	
....	9000	....	−35.6	....	77	....	....	
5 39.0	9364	229.3	−38.4	0.7	77	....	....	
....	10000	....	−43.1	....	75	....	....	
5 44.2	10576	192.3	−47.2	0.7	74	....	....	
....	11000	....	−49.9	....	74	....	....	
5 49.8	11806	159.6	−53.7	0.5	74	....	....	
....	12000	....	−54.0	....	74	....	....	
5 54.9	12825	136.7	−55.2	0.1	72	....	....	
....	13000	....	−55.6	....	72	....	....	
....	14000	....	−57.9	....	71	....	....	
6 00.8	14222	109.9	−58.4	0.2	71	....	....	Inversion.
6 01.9	14467	105.8	−57.9	−0.2	70	....	....	
....	15000	....	−57.9	....	70	....	....	
6 04.4	15180	94.6	−57.9	0.0	70	....	....	
6 04.9	15418	91.1	−58.3	0.2	69	....	....	
....	16000	....	−56.9	....	69	....	....	
6 08.1	16353	78.8	−56.0	−0.2	69	....	....	
....	17000	....	−56.1	....	69	....	....	
6 10.7	17258	68.3	−56.2	0.0	69	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 14, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ \text{m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
4 46.2	392	734.8	20.5	....	51	S. 22° E.	6.3	
....	500	....	19.3	....	54	S. 20° E.	6.5	
....	1000	....	14.0	....	68	S. 10° E.	7.4	
4 51.0	1306	659.4	10.7	1.1	77	S. 4° E.	7.9	2/10 A.-Cu. WNW. 5/10 St.-Cu. WSW.
....	1500	....	10.1	....	81	S.	8.1	
4 53.5	1963	609.1	8.8	0.3	92	S. 9° W.	9.2	
....	2500	....	8.4	....	95	S. 32° W.	8.3	
4 56.3	2716	555.9	8.2	0.1	96	S. 41° W.	7.9	
....	3000	....	6.3	....	92	S. 50° W.	7.7	
....	3500	....	3.0	....	86	S. 66° W.	7.4	
....	4000	....	− 0.2	....	80	S. 82° W.	7.1	
5 02.7	4077	469.9	− 0.7	0.7	79	S. 85° W.	7.1	
....	4500	....	− 3.3	....	79	N. 88° W.	8.7	
....	5000	....	− 6.4	....	78	N. 79° W.	10.6	
5 09.8	5510	391.6	− 9.5	0.6	78	N. 70° W.	12.5	Balloon in A.-Cu. at 5:13 p. m.
....	6000	....	−13.1	....	78	....	....	
....	7000	....	−20.4	....	78	....	....	
5 19.9	7364	306.2	−23.0	0.7	78	....	....	
....	8000	....	−27.9	....	75	....	....	
5 25.2	8522	261.2	−31.9	0.8	72	....	....	3/10 A.-Cu. WNW. 6/10 St.-Cu. WSW.
....	9000	....	−35.5	....	71	....	....	
5 29.9	9443	228.8	−38.8	0.8	70	....	....	
....	10000	....	−42.5	....	68	....	....	
5 34.6	10515	196.0	−45.9	0.7	66	....	....	
....	11000	....	−48.5	....	66	....	....	
5 37.0	11074	180.1	−48.9	0.5	66	....	....	
5 40.6	11916	157.7	−53.2	0.5	66	....	....	
....	12000	....	−53.4	....	66	....	....	
....	13000	....	−55.5	....	66	....	....	
5 43.3	13162	131.0	−55.9	0.2	66	....	....	Inversion.
5 44.6	13681	121.2	−54.9	−0.2	65	....	....	
....	14000	....	−55.5	....	65	....	....	
5 48.4	15032	98.3	−57.6	0.2	64	....	....	Inversion.
5 50.6	16046	83.9	−56.7	−0.1	63	....	....	Balloon burst.

SEPTEMBER 15, 1910.

4 34.0	392	729.2	20.9	....	68	S. 45° E.	5.8	
....	500	....	19.5	....	72	S. 46° E.	6.0	
....	1000	....	13.0	....	92	S. 52° E.	7.0	Few Ci. NW.
4 37.5	1216	661.4	10.1	1.3	100	S. 54° E.	7.4	Inversion.
....	1500	....	10.4	....	87	S. 81° W.	6.0	
4 41.0	1836	613.8	10.7	−0.1	73	S. 81° W.	4.6	
....	2000	....	9.9	....	64	S. 87° W.	4.9	
....	2500	....	7.3	....	43	N. 77° W.	5.5	
4 45.5	2680	553.9	6.4	0.5	34	N. 71° W.	5.8	
....	3000	....	3.9	....	39	N. 68° W.	7.0	
....	3500	....	0.1	....	48	N. 64° W.	8.9	
4 49.6	3637	492.1	− 1.0	0.8	50	N. 63° W.	9.3	
....	4000	....	− 2.7	....	49	N. 66° W.	9.5	
....	4500	....	− 5.1	....	46	N. 69° W.	9.8	
4 53.8	4568	437.2	− 5.4	0.5	46	N. 70° W.	9.8	2/10 Ci. NW.
....	5000	....	− 8.7	....	41	N. 66° W.	8.8	
4 58.3	5671	379.3	−13.6	0.7	32	N. 58° W.	7.0	Meteorograph clock stopped.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 16, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 42.5	392	723.3	32.6	....	44	S. 45° E.	5.4	
....	500	....	31.5	....	....	S. 23° E.	5.8	Cloudless.
....	1000	....	26.6	....	....	S. 23° E.	7.9	
4 46.0	1093	668.2	25.5	1.0	....	S. 23° E.	8.3	
....	1500	....	22.9	....	....	S. 15° W.	9.7	
4 48.5	1560	633.3	22.5	0.6	....	S. 15° W.	10.0	
....	2000	....	21.6	....	....	S. 42° W.	16.2	
4 50.7	2163	590.5	21.3	0.2	....	S. 42° W.	19.3	
....	2500	....	17.9	....	....	S. 79° W.	....	
4 54.3	2800	548.1	14.7	1.0	....	S. 79° W.	11.0	
....	3000	....	12.7	....	....	S. 82° W.	10.3	
4 57.9	3412	509.3	8.8	1.0	....	S. 87° W.	8.9	
....	3500	....	8.0	....	....	S. 88° W.	8.8	
....	4000	....	3.8	....	....	N. 84° W.	8.5	
5 01.5	4090	468.7	2.9	0.9	....	N. 83° W.	8.4	
....	4500	....	1.0	....	....	N. 79° W.	10.4	
5 05.4	4890	424.4	− 1.0	0.5	....	N. 76° W.	12.1	
....	5000	....	− 1.7	....	....	N. 75° W.	11.9	
5 09.4	5641	386.1	− 5.5	0.6	....	N. 66° W.	10.4	
....	6000	....	− 8.0	....	....	N. 75° W.	9.4	
5 13.7	6476	346.5	−11.6	0.7	....	S. 87° W.	8.2	
....	7000	....	−15.4	....	....	S. 89° W.	10.1	
5 17.7	7378	307.9	−18.0	0.7	....	W.	11.7	
....	8000	....	−22.4	....	....	N. 83° W.	11.4	
5 21.3	8168	276.9	−23.6	0.7	....	N. 81° W.	11.3	
....	9000	....	−30.7	....	....	N. 68° W.	10.6	
5 26.0	9067	244.4	−31.3	0.9	....	N. 67° W.	10.5	Meteorograph clock ran irregularly after 5:25 p. m.
....	10000	....	−36.8	....	....	N. 64° W.	12.1	
....	11000	....	−42.7	....	....	N. 61° W.	13.8	
....	12000	....	−48.6	....	....	N. 58° W.	15.6	
....	12852	141.0	−53.6	0.6	....	N. 55° W.	17.2	
....	13000	....	−54.2	....	....	N. 53° W.	16.9	
....	14000	....	−58.6	....	....	N. 39° W.	14.1	
....	14071	117.0	−58.9	0.4	....	N. 39° W.	13.8	
....	15000	....	....	....	....	N. 36° W.	12.9	
....	16000	....	....	....	....	N. 32° W.	12.0	
....	17000	....	....	....	....	N. 29° W.	11.1	
....	....	....	−62.1	....	....	....	....	Inversion.
....	18000	....	....	....	....	N. 25° W.	10.0	
....	19000	....	....	....	....	N. 21° W.	9.0	
6 01.8	19756	48.2	−53.9	....	....	N. 19° W.	8.1	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

THIRD SERIES, HURON—Continued.

SEPTEMBER 17, 1910.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
a. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
7 01.0	392	723.7	18.2	....	82	S.	3.1	Inversion. 5/10 A.-Cu. WNW.[1]
....	500	....	18.7	....	77	S.	3.4	
....	1000	....	21.2	....	54	N. 13° W.	4.7	
7 06.4	1420	642.2	23.3	−0.5	34	N. 13° W.	5.7	
....	1500	....	22.7	....	35	N. 75° W.	5.8	
....	2000	....	18.5	....	37	N. 75° W.	6.3	
....	2500	....	14.2	....	39	N. 75° W.	6.8	
....	3000	....	9.9	....	41	N. 75° W.	7.3	
....	3500	....	5.7	....	44	N. 75° W.	7.8	
7 18.1	3936	475.4	2.2	0.8	46	N. 75° W.	8.2	
....	4000	....	1.7	....	47	N. 75° W.	8.2	
....	4500	....	− 2.6	....	53	N. 77° W.	8.0	
....	5000	....	− 6.9	....	59	N. 79° W.	7.9	
7 26.7	5568	386.4	−11.4	0.8	66	S. 88° W.	7.8	
....	6000	....	−13.2	....	62	N. 67° W.	9.0	
7 34.2	6892	324.8	−17.3	0.4	52	N. 67° W.	11.6	Balloon in A.-Cu. at 7.36 a. m.
....	7000	....	−18.1	....	52	....	....	
....	8000	....	−25.2	....	47	....	....	
7 42.3	8260	269.9	−27.0	0.7	46	....	....	
....	9000	....	−32.6	....	44	....	....	
7 52.5	9646	222.1	−37.6	0.8	41	....	....	
....	10000	....	−39.0	....	39	....	....	
7 57.8	10098	208.3	−89.4	0.4	39	....	....	Inversion.
8 03.5	10294	202.6	−35.0	−2.2	37	....	....	Highest altitude. 3/10 A.-Cu. WNW.

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[1] Balloon made a rapid semicircle to the right, entering a current from the north about a minute after it was launched.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA.

FEBRUARY 8, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 45.0	312	739.2	5.4		66	S. 45° W.	2.7	Cloudless.
	500		3.5			S. 51° W.	3.6	
	1000		− 1.5			S. 65° W.	5.9	
	1500		− 6.6			S. 80° W.	8.3	
4 50.4	1780	614.4	− 9.5	1.0		S. 88° W.	9.5	
	2000		−10.4			S. 89° W.	10.7	
	2500		−12.6			N. 88° W.	13.5	
	3000		−14.9			N. 85° W.	16.3	
	3500		−17.1			N. 83° W.	19.0	
	4000		−19.3			N. 80° W.	21.8	
4 56.0	4186	447.1	−20.1	0.4		N. 79° W.	22.8	
	4500		−22.3			N. 81° W.	23.5	
	5000		−25.8			N. 84° W.	24.8	
5 00.9	5999	348.1	−32.9	0.7		N. 89° W.	27.2	
	7000		−38.0			N. 89° W.	33.2	
	8000		−43.2			W.	39.2	
5 06.6	8232	252.0	−44.4	0.5		W.	40.6	
	9000		−46.2			S. 82° W.	42.0	
5 11.0	9554	206.8	−47.4	0.2		S. 77° W.	43.0	Inversion.
	10000		−47.1			S. 77° W.	41.9	
5 14.0	10580					S. 78° W.	40.4	
	11000		−46.5					Balloon disappeared 5:14 p. m.
5 18.4	12085	141.2	−45.7	−0.1				
	13000		−46.4					
5 23.3	13805	109.7	−47.1	0.1				Balloon went slightly higher but record was partially effaced on landing.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 9, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 55.0	312	742.4	− 4.4	....	58	N. 45° W.	4.5	
....	500	....	− 5.1	....	56	N. 45° W.	5.3	
....	1000	....	− 7.2	....	48	N. 44° W.	8.5	Cloudless.
3 55.0	1470	640.1	− 9.0	0.4	43	N. 43° W.	9.6	Inversion.
....	1500	....	− 8.8	....	43	N. 42° W.	10.9	
3 56.0	1639	626.2	− 8.5	−0.3	42	N. 38° W.	17.0	
....	2000	....	−10.4	....	42	N. 42° W.	18.8	
....	2500	....	−13.0	....	43	N. 48° W.	21.3	
4 01.5	2934	528.8	−15.1	0.5	44	N. 53° W.	23.4	Inversion.
....	3000	....	−14.8	....	43	N. 51° W.	24.3	
4 02.6	3181	511.8	−14.2	−0.4	40	N. 47° W.	26.7	
....	3500	....	−15.9	....	39	N. 46° W.	28.1	
....	4000	....	−18.8	....	38	N. 45° W.	30.3	
....	4500	....	−21.6	....	37	N. 44° W.	32.5	
4 10.2	4805	411.6	−23.3	0.6	36	N. 43° W.	33.8	Balloon disappeared.
....	5000	....	−25.0	....	36	....	....	
....	6000	....	−32.4	....	35	....	....	
4 17.0	6194	339.0	−33.9	0.8	35	....	....	
....	7000	....	−41.0	....	35	....	....	
4 23.9	7762	269.8	−47.3	0.9	35	....	....	
....	8000	....	−49.0	....	35	....	....	
....	9000	....	−55.2	....	34	....	....	
4 30.5	9309	212.8	−57.1	0.6	34	....	....	
....	10000	....	−57.6	....	33	....	....	
4 34.8	10669	172.5	−57.9	0.1	32	....	....	Inversion.
....	11000	....	−57.2	....	32	....	....	
....	12000	....	−54.7	....	31	....	....	
4 41.6	12874	122.4	−52.4	−0.2	30	....	....	
....	13000	....	−52.6	....	30	....	....	
....	14000	....	−54.2	....	30	....	....	
4 46.2	14751	....	−55.3	0.2	29	....	....	Inversion.
4 46.6	14914	....	−54.3	−0.6	29	....	....	
....	15000	....	−54.6	....	29	....	....	
4 48.5	15692	79.0	−57.0	0.3	29	....	....	Inversion.
....	16000	....	−56.1	....	29	....	....	
4 50.0	16178	....	−55.6	−0.3	29	....	....	
4 51.4	16631	....	−57.1	0.3	29	....	....	Inversion.
4 52.4	16956	....	−55.9	−0.4	29	....	....	
....	17000	....	−56.0	....	29	....	....	
....	18000	....	−56.5	....	29	....	....	
4 57.2	18500	50.7	−56.7	0.1	29	....	....	Inversion.
....	19000	....	−55.5	....	29	....	....	
5 00.1	19740	41.8	−54.0	−0.2	29	....	....	
....	20000	....	−54.0	....	29	....	....	
....	21000	....	−53.9	....	29	....	....	
5 03.5	21260	33.0	−53.9	0.0	29	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 10, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 40.5	312	732.8	7.2	....	45	S. 22° E.	4.5	
....	500	....	7.1	....	43	S. 14° E.	7.5	
....	1000	....	6.2	....	40	S.	15.0	
3 46.2	1072	668.1	6.2	0.2	38	S. 4° W.	16.0	
....	1500	....	3.2	....	36	S. 25° W.	24.5	
3 50.4	1593	626.7	2.7	0.7	35	S. 29° W.	27.8	Inversion.
....	2000	....	2.8	....	34	....	....	Balloon disappeared on account of smoke 3:51 p. m.
3 54.2	2150	585.2	2.8	0.0	33	....	....	
....	2500	....	− 0.2	....	33	....	....	
....	3000	....	− 4.4	....	33	....	....	
4 01.5	3316	505.3	− 6.9	0.8	33	....	....	
....	3500	....	− 7.2	....	31	....	....	
4 03.0	3594	487.6	− 7.3	0.1	30	....	....	
....	4000	....	−11.1	....	29	....	....	
....	4500	....	−15.7	....	27	....	....	
4 09.4	4642	425.1	−17.0	0.9	26	....	....	
....	5000	....	−19.3	....	26	....	....	
4 15.0	5553	376.3	−22.9	0.6	25	....	....	
....	6000	....	−26.7	....	24	....	....	
4 20.0	6889	312.3	−34.4	0.9	23	....	....	
....	7000	....	−35.2	....	22	....	....	
....	8000	....	−42.4	....	20	....	....	
4 26.0	8616	242.9	−46.9	0.7	19	....	....	
....	9000	....	−48.0	....	19	....	....	
....	10000	....	−50.8	....	20	....	....	
....	11000	....	−53.6	....	21	....	....	
4 35.0	11292	161.9	−54.3	0.3	21	....	....	Inversion.
....	12000	....	−54.2	....	21	....	....	
....	13000	....	−54.1	....	21	....	....	
....	14000	....	−54.0	....	21	....	....	
4 47.6	14158	103.9	−54.0	0.0	21	....	....	
....	15000	....	−54.1	....	21	....	....	
....	16000	....	−54.1	....	20	....	....	
....	17000	....	−54.2	....	20	....	....	
4 59.2	17211	65.0	−54.2	0.0	20	....	....	Inversion.
....	18000	....	−53.7	....	20	....	....	
....	19000	....	−53.3	....	20	....	....	
5 09.1	19614	44.9	−52.8	−0.1	20	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 11, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ \text{m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	°*C.*		*Per cent.*		*m. p. s.*	
3 39.0	312	733.0	7.3	....	69	S.	3.6	Few. St.-Cu. SW.
....	500	....	5.7	....	72	S. 10° W.	5.4	
....	1000	....	1.4	....	80	S. 25° W.	9.5	
3 44.3	1080	667.0	0.7	0.9	82	S. 28° W.	10.2	Inversion.
3 45.4	1322	647.5	9.2	−3.5	58	S. 58° W.	10.6	
....	1500	....	8.0	....	54	S. 64° W.	9.8	
....	2000	....	4.5	....	42	S. 72° W.	8.8	
....	2500	....	1.0	....	30	S. 80° W.	7.8	
3 52.3	2617	552.4	0.1	0.7	26	S. 84° W.	7.2	
....	3000	....	− 2.2	....	24	S. 88° W.	9.5	
....	3500	....	− 5.3	....	22	N. 86° W.	12.0	
3 58.9	3881	470.6	− 7.7	0.6	21	N. 82° W.	14.3	
....	4000	....	− 8.6	....	21	N. 80° W.	15.4	
....	4500	....	−12.3	....	20	N. 76° W.	17.2	
....	5000	....	−15.9	....	20	N. 72° W.	19.4	
4 06.6	5363	387.6	−18.6	0.7	20	N. 70° W.	20.7	Balloon disappeared 4:07.5 p. m.
....	6000	....	−23.5	....	19	....	....	
4 11.8	6462	333.7	−27.0	0.8	19	....	....	
....	7000	....	−28.7	....	19	....	....	
4 15.0	7093	305.6	−29.0	0.3	19	....	....	
....	8000	....	−32.7	....	19	....	....	
....	9000	....	−36.8	....	18	....	....	
4 24.4	9105	229.9	−37.3	0.4	18	....	....	
....	10000	....	−39.1	....	18	....	....	
....	11000	....	−41.2	....	17	....	....	
4 33.8	11091	172.4	−41.4	0.2	17	....	....	
....	12000	....	−43.6	....	16	....	....	
4 38.5	12059	149.6	−43.7	0.2	16	....	....	
....	13000	....	−48.0	....	15	....	....	
4 45.1	13752	115.7	−51.4	0.5	14	....	....	
....	14000	....	−51.8	....	14	....	....	
....	15000	....	−53.5	....	14	....	....	
4 48.9	15063	94.7	−53.6	0.2	14	....	....	Inversion.
4 51.1	15748	85.3	−54.1	0.1	14	....	....	
....	16000	....	−54.0	....	14	....	....	
4 55.5	16763	73.1	−53.5	−0.1	14	....	....	
....	17000	....	−53.1	....	14	....	....	
....	18000	....	−51.5	....	14	....	....	
5 01.3	18025	60.4	−51.5	−0.2	14	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 12, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 37.0	312	728.3	8.2	....	85	S. 22° E.	3.6	8/10 St.-Cu. S.
....	500	....	7.0	....	89	S. 17° E.	5.6	
3 39.1	754	690.1	5.3	0.7	96	S. 9° E.	8.3	Inversion. Balloon in clouds.
....	1000	....	7.1	....	87	....	....	
3 40.7	1090	662.5	7.7	−0.7	83	....	....	
3 42.1	1478	632.5	15.2	−1.9	37	....	....	
....	1500	....	15.0	....	37	....	....	
....	2000	....	10.7	....	27	....	....	
....	2500	....	6.5	....	17	....	....	
3 48.7	2932	530.7	2.8	0.9	8	....	....	
....	3000	....	2.5	....	8	....	....	
3 50.9	3500	494.6	0.7	0.4	5	....	....	
....	4000	....	− 3.5	....	4	....	....	
3 53.1	4036	462.6	− 3.8	0.8	4	....	....	
....	4500	....	− 5.2	....	4	....	....	
3 55.9	4728	423.4	− 5.9	0.3	4	....	....	
....	5000	....	− 8.4	....	5	....	....	
....	6000	....	−17.7	....	6	....	....	
4 02.7	6239	347.4	−20.0	0.9	7	....	....	
....	7000	....	−24.5	....	7	....	....	
....	8000	....	−30.5	....	8	....	....	
....	9000	....	−36.4	....	8	....	....	
4 17.0	9319	226.2	−38.3	0.6	8	....	....	
....	10000	....	−41.5	....	7	....	....	
4 21.6	10450	192.1	−43.7	0.5	6	....	....	
....	11000	....	−45.4	....	5	....	....	
....	12000	....	−48.6	....	4	....	....	
4 29.4	12658	137.8	−50.8	0.3	3	....	....	
....	13000	....	−51.7	....	3	....	....	
....	14000	....	−54.2	....	2	....	....	
4 33.7	14226	108.6	−54.8	0.3	2	....	....	
4 34.5	14608	102.2	−54.9	0.0	2	....	....	
....	15000	....	−55.4	....	2	....	....	
4 37.9	15838	84.7	−56.5	0.1	2	....	....	
....	16000	....	−56.6	....	2	....	....	
....	17000	....	−56.9	....	2	....	....	
4 41.0	17055	69.9	−56.9	0.0	2	....	....	Inversion.
4 43.0	17571	64.5	−56.1	−0.2	2	....	....	Balloon burst.

FEBRUARY 13, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
3 49.5	312	724.8	1.6	....	100	N. 22° W.	4.0	10/10 Nb. NNW.
....	500	....	0.9	....	100	....	....	Lt. rain all day.
3 51.0	689	691.5	0.1	0.4	100	....	....	Inversion. Balloon in clouds 3:50.5 p. m.
....	1000	....	4.0	....	99	....	....	
3 53.4	1151	653.1	5.9	−1.3	99	....	....	
....	1500	....	5.4	....	97	....	....	
3 58.3	1814	602.3	4.9	0.2	95	....	....	
....	2000	....	3.8	....	95	....	....	
....	2500	....	1.0	....	94	....	....	
4 04.4	2538	550.8	0.8	0.6	94	....	....	
....	3000	....	−0.8	....	94	....	....	
....	3500	....	−2.5	....	94	....	....	
....	4000	....	−4.2	....	94	....	....	
4 23.3	4040	456.0	−4.3	0.3	94	....	....	
....	4500	....	−7.8	....	93	....	....	
5 30.8	4548	427.2	−8.2	0.8	93	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 14, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\,m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 55.0	312	729.7	5.6	....	73	E.	1.8	Few Ci. W.
....	500	....	4.3	....	75	S. 75° E.	2.0	
3 56.9	648	700.2	3.2	0.7	76	S. 62° E.	2.1	Inversion.
3 58.4	950	674.8	7.4	−1.4	53	S. 23° W.	3.6	
....	1000	....	7.4	....	53	S. 29° W.	3.9	
4 01.0	1443	635.7	7.4	0.0	49	S. 83° W.	6.4	
....	1500	....	7.0	....	48	S. 83° W.	6.4	
....	2000	....	3.5	....	41	S. 78° W.	6.4	
4 04.8	2039	591.0	3.2	0.7	40	S. 78° W.	6.4	
....	2500	....	− 0.7	....	34	S. 89° W.	5.4	
4 08.1	2623	549.4	− 1.8	0.9	32	N. 88° W.	5.1	
4 09.1	2736	541.8	− 1.4	−0.4	35	N. 85° W.	6.3	
....	3000	....	− 3.1	....	34	W.	7.0	
....	3500	....	− 6.4	....	32	S. 81° W.	8.4	
4 16.0	3956	463.8	− 9.4	0.7	31	S. 73° W.	9.7	
....	4000	....	− 9.8	....	31	S. 73° W.	10.1	
....	4500	....	−13.0	....	31	S. 69° W.	14.1	
....	5000	....	−16.2	....	32	S. 66° W.	18.0	
4 23.2	5258	390.5	−17.9	0.7	32	S. 64° W.	20.1	Balloon disappeared.
4 26.9	5935	356.9	−20.8	0.4	31	....	....	
....	6000	....	−21.2	....	31	....	....	
....	7000	....	−27.7	....	31	....	....	
4 32.9	7320	295.2	−29.8	0.6	31	....	....	
....	8000	....	−35.2	....	30	....	....	
4 38.7	8904	235.0	−42.4	0.8	29	....	....	
....	9000	....	−42.7	....	29	....	....	
....	10000	....	−45.8	....	29	....	....	
....	11000	....	−48.8	....	29	....	....	
4 47.3	11536	....	−50.5	0.3	29	....	....	Inversion.
....	12000	....	−50.3	....	29	....	....	
....	13000	....	−49.8	....	28	....	....	
4 52.7	13176	123.2	−49.7	0.0	28	....	....	
....	14000	....	−52.1	....	28	....	....	
....	15000	....	−55.0	....	28	....	....	
5 00.3	15365	....	−56.1	0.3	28	....	....	Inversion.
....	16000	....	−54.4	....	28	....	....	
5 02.9	16114	....	−54.1	−0.3	28	....	....	
....	17000	....	−56.4	....	27	....	....	
5 06.4	17122	....	−56.7	0.3	27	....	....	
....	18000	....	−56.7	....	27	....	....	
....	19000	....	−56.7	....	27	....	....	
5 13.7	19224	....	−56.7	0.0	27	....	....	Inversion.
5 16.5	19991	42.9	−54.4	−0.3	27	....	....	
5 18.7	20581	39.0	−53.4	−0.2	27	....	....	
....	21000	....	−53.5	....	27	....	....	
5 21.8	21544	33.7	−53.6	0.0	27	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 15, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 04.0	312	734.0	7.8	....	73	N. 45° W.	5.4	Few Ci. WSW.
....	500	....	6.2	....	78	N. 38° W.	6.2	
4 07.4	916	681.8	2.7	−0.9	84	N. 28° W.	6.6	Inversion.
....	1000	....	3.5	....	80	N. 35° W.	6.7	
....	1500	....	8.4	....	60	S. 65° W.	6.8	
4 11.0	1565	629.8	9.0	−1.0	54	S. 70° W.	6.9	
....	2000	....	7.2	....	42	S. 69° W.	9.4	
....	2500	....	5.1	....	27	S. 68° W.	12.0	
4 16.5	2610	554.6	4.6	0.4	23	S. 68° W.	13.4	
....	3000	....	1.3	....	22	S. 67° W.	16.0	
....	3500	....	− 2.9	....	20	S. 65° W.	19.0	
....	4000	....	− 7.1	....	19	S. 63° W.	22.0	
4 24.0	4020	464.7	− 7.3	0.8	19	S. 63° W.	22.2	Balloon disappeared 4:26 p. m.
....	4500	....	−10.7	....	19	....	....	
....	5000	....	−14.3	....	20	....	....	
....	6000	....	−21.5	....	20	....	....	
....	7000	....	−28.7	....	21	....	....	
4 40.9	7133	306.4	−29.6	0.7	21	....	....	
....	8000	....	−36.4	....	20	....	....	
4 49.7	8850	239.8	−43.0	0.8	20	....	....	
....	9000	....	−43.8	....	20	....	....	
....	10000	....	−49.1	....	21	....	....	
4 56.5	10371	191.0	−51.1	0.5	21	....	....	
....	11000	....	−54.2	....	21	....	....	
5 02.9	11835	152.6	−58.3	0.5	20	....	....	Inversion.
....	12000	....	−58.1	....	20	....	....	
....	13000	....	−56.8	....	20	....	....	
....	14000	....	−55.5	....	19	....	....	
5 12.5	14214	105.3	−55.2	−0.1	19	....	....	
....	15000	....	−58.0	....	19	....	....	
5 17.0	15652	84.5	−60.4	0.4	19	....	....	Inversion.
....	16000	....	−60.2	....	19	....	....	
....	17000	....	−59.6	....	19	....	....	
....	18000	....	−59.0	....	19	....	....	
....	19000	....	−58.4	....	19	....	....	
....	20000	....	−57.9	....	19	....	....	
....	21000	....	−57.3	....	19	....	....	
5 33.4	21070	35.8	−57.3	−0.1	19	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 16, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. h. m.	m.	mm.	°C.		Per cent.		m. p. s.	
3 38.0	312	735.2	3.1	....	96	N.	4.0	10/10 Nb. N. Lt. rain.
....	500	....	2.9	....	94	....	....	
....	1000	....	2.4	....	92	....	....	Balloon in clouds 3:39 p. m.
....	1500	....	1.8	....	90	....	....	
3 46.7	1816	610.3	1.4	0.1	88	....	....	
....	2000	....	0.4	....	88	....	....	
....	2500	....	− 2.4	....	88	....	....	
....	3000	....	− 5.1	....	89	....	....	
3 55.5	3244	509.8	− 6.4	0.5	89	....	....	
....	3500	....	− 7.5	....	....	....	....	
3 59.2	3885	469.3	− 9.2	0.4	....	....	....	
....	4000	....	−10.0	....	....	....	....	
....	4500	....	−13.2	....	....	....	....	
4 04.9	4905	410.7	−15.9	0.7	....	....	....	
....	5000	....	−16.0	....	....	....	....	
4 06.6	5109	399.7	−16.2	0.1	....	....	....	
....	6000	....	−23.4	....	....	....	....	
4 12.9	6192	345.4	−25.0	0.8	....	....	....	
4 15.9	6769	318.8	−26.3	0.2	....	....	....	
....	7000	....	−27.9	....	....	....	....	
....	8000	....	−34.8	....	....	....	....	
4 25.4	8581	247.1	−38.8	0.7	....	....	....	
....	9000	....	−40.4	....	....	....	....	
4 28.7	9175	226.5	−41.0	0.4	....	....	....	
....	10000	....	−46.9	....	....	....	....	
4 35.8	10524	185.5	−50.7	0.7	....	....	....	
....	11000	....	−53.2	....	....	....	....	
4 41.0	11778	153.0	−57.3	0.5	58	....	....	
....	12000	....	−58.0	....	59	....	....	
....	13000	....	−61.3	....	60	....	....	
4 46.4	13067	124.8	−61.5	0.3	60	....	....	Inversion.
....	14000	....	−59.8	....	60	....	....	
4 49.6	14248	103.6	−59.3	−0.2	60	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 17, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 37.0	312	742.7	1.0		93	N.	5.8	10/10 St. NNE.
	500		− 0.3			N. 5° E.	7.5	Lt. rain ended 3:30 p. m.
	1000		− 3.7			N. 17° E.	12.0	
3 40.7	1072	675.0	− 4.1	0.7		N. 19° E.	12.6	Inversion. Balloon in clouds 3:41 p. m.
3 41.1	1156	667.8	− 2.6	−1.8				
	1500		− 2.9					
3 45.4	1965	602.9	− 3.4	0.1				Inversion.
	2000		− 3.1					
3 46.7	2186	580.4	− 1.3	−1.0				
	2500		− 1.6					
3 50.0	2850	539.5	− 2.0	0.1				Inversion.
	3000		− 0.9					
3 51.0	3059	525.5	− 0.4	−0.8				
	3500		− 3.0					
	4000		− 5.9					
3 56.6	4051	463.6	− 6.2	0.6				
	4500		− 8.0					
	5000		−10.0					
	6000		−14.1					
4 07.0	6064	356.8	−14.4	0.4				
	7000		−20.4					
4 14.7	7746	284.6	−25.2	0.6				
	8000		−27.1					
	9000		−34.5					
4 24.5	9783	213.3	−40.3	0.7				
	10000		−41.4					
4 27.9	10314	197.5	−42.9	0.5				
	11000		−44.0					
4 31.7	11363	169.2	−46.1	0.3				
	12000		−49.7					
	13000		−55.2					
4 37.8	13135	129.3	−56.0	0.6				
4 39.6	13669	118.8	−56.6	0.1				Inversion.
	14000		−55.8					
4 41.3	14248	108.8	−55.2	−0.2				
4 42.4	14641	102.4	−56.2	0.3				Inversion.
	15000		−55.3					
4 44.4	15331	92.0	−54.5	−0.2				
4 46.0	15951	83.4	−55.5	0.2				
	16000		−55.5					
4 47.4	16275	79.3	−55.5	0.0				
4 48.8	16898	72.1	−55.5	0.0				Inversion.
	17000		−55.2					
4 50.7	17394	66.7	−53.9	−0.3				
	18000		−53.9					
	19000		−54.0					
	20000		−54.0					
	20272	42.9	−54.0	0.0				Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 18, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 35.0	312	743.6	0.4	....	74	N.	8.0	10/10 St.-Cu. SW.
....	500	....	− 1.4	....	77	N. 6° E.	8.8	
....	1000	....	− 6.0	....	83	N. 13° E.	10.8	
3 38.6	1053	677.3	− 6.5	0.9	84	N. 14° E.	11.0	Inversion.
3 39.7	1260	659.5	− 5.0	−0.7	67	N. 22° E.	15.3	
....	1500	....	− 5.7	....	62	N. 18° E.	13.6	
....	2000	....	− 7.1	....	50	N. 11° E.	10.0	
3 45.0	2403	569.8	− 8.3	0.3	41	N. 19° E.	10.9	
....	2500	....	− 8.4	....	40	N. 15° E.	11.6	
....	3000	....	− 9.1	....	34	N. 5° W.	7.2	
3 50.7	3551	....	− 9.9	....	28	S. 55° W.	1.9	
3 52.7	3954	466.2	−10.3	0.1	47	S. 23° W.	4.1	
....	4000	....	−10.5	....	48	S. 23° W.	4.1	
....	4500	....	−12.3	....	63	S. 38° W.	22.2	
....	5000	....	−14.1	....	78	....	....	Balloon in clouds 3:56 p. m.
3 58.4	5154	398.2	−14.7	0.4	82	....	....	
4 01.0	5764	367.3	−20.0	0.9	84	....	....	Inversion.
4 02.0	5976	356.8	−18.2	−0.8	69	....	....	
....	6000	....	−18.4	....	68	....	....	
4 06.0	6916	313.9	−27.0	0.9	48	....	....	
....	7000	....	−27.2	....	48	....	....	
4 07.1	7166	303.5	−27.5	0.2	48	....	....	
....	8000	....	−34.7	....	43	....	....	
4 11.8	8228	261.0	−36.7	0.9	42	....	....	
4 14.2	8836	239.1	−38.9	0.4	40	....	....	
....	9000	....	−40.3	....	40	....	....	
....	10000	....	−49.1	....	39	....	....	
4 20.9	10542	185.5	−53.8	0.9	38	....	....	
....	11000	....	−55.0	....	38	....	....	
....	12000	....	−57.8	....	37	....	....	
4 27.1	12276	141.7	−58.5	0.3	36	....	....	Inversion.
....	13000	....	−58.1	....	36	....	....	
4 29.4	13052	125.5	−58.1	−0.1	36	....	....	
....	14000	....	−58.2	....	36	....	....	
....	15000	....	−58.3	....	36	....	....	
....	16000	....	−58.4	....	36	....	....	
....	17000	....	−58.5	....	35	....	....	
....	18000	....	−58.7	....	35	....	....	
....	19000	....	−58.8	....	35	....	....	
4 45.7	19289	47.0	−58.8	0.0	35	....	....	
....	20000	....	−58.8	....	35	....	....	Inversion.
....	21000	....	−58.7	....	34	....	....	
4 55.2	22187	29.7	−58.7	0.0	33	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 21, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 52.0	312	753.0	− 4.0	....	44	N. 45° W.	6.3	Few Ci. E.
....	500	....	− 7.6	....	44	N. 41° W.	6.5	
3 54.8	741	712.5	−12.3	1.9	43	N. 36° W.	6.7	Inversion.
....	1000	....	−10.7	....	41	N. 22° W.	7.2	
3 59.6	1143	676.2	− 9.8	−0.6	40	N. 15° W.	7.5	
....	1500	....	−10.6	....	36	N. 1° W.	8.1	
4 00.6	1847	617.0	−11.4	0.2	33	N. 12° E	8.7	
....	2000	....	−12.4	....	33	N. 13° E.	9.2	
4 03.4	2437	571.0	−15.4	0.7	32	N. 15° E.	10.7	
....	2500	....	−15.8	....	32	N. 16° E.	10.6	
....	3000	....	−18.9	....	32	N. 23° E.	10.1	
....	3500	....	−22.0	....	33	N. 31° E.	9.6	
4 09.9	3621	487.0	−22.7	0.6	33	N. 33° E.	9.5	
....	4000	....	−23.2	....	32	N. 46° E.	9.0	
4 12.4	4116	....	−23.4	0.1	32	N. 50° E.	8.7	
....	4500	....	−24.9	....	31	N. 62° E.	8.3	
4 15.6	4761	416.2	−26.0	0.4	31	N. 71° E.	7.9	
....	5000	....	−28.1	....	32	N. 74° E.	9.6	
4 18.6	5373	....	−31.4	0.9	32	N. 78° E.	12.3	
....	6000	....	−35.9	....	33	N. 85° E.	16.9	
4 21.9	6064	346.7	−36.4	0.7	34	N. 85° E.	17.4	
4 24.8	6663	317.7	−41.7	0.9	33	S. 86° E.	19.1	
....	7000	....	−44.2	....	33	N. 87° E.	20.5	
4 27.8	7166	294.6	−45.4	0.7	33	N. 84° E.	21.1	
4 31.0	7903	263.6	−51.0	0.8	31	S. 88° E.	23.6	
....	8000		−50.9	....	31	S. 88° E.	23.1	
4 31.8	8066	....	−50.8	−0.1	31	S. 87° E.	22.7	
4 33.2	8352	....	−52.6	0.6	31	S. 86° E.	21.1	
4 35.7	8856	228.0	−53.1	0.1	30	S. 84° E.	18.3	Inversion.
....	9000	....	−53.0	....	30	N. 71° E.	16.2	
4 41.4	10010	191.4	−52.6	0.0	30	N. 61° W.	1.2	
4 44.9	10806	169.3	−51.6	−0.1	32	N. 79° W.	9.6	
....	11000	....	−51.9	....	32	N. 79° W.	9.8	
....	12000	....	−53.5	....	31	N. 81° W.	11.1	
....	13000	....	−55.2	....	31	N. 82° W.	12.3	
....	14000	....	−56.8	....	31	N. 83° W.	13.5	
....	15000	....	−58.4	....	30	N. 85° W.	14.8	
5 00.6	15437	82.3	−59.1	0.2	30	N. 86° W.	15.3	
....	16000	....	−59.7	....	31	N. 84° W.	14.3	
....	17000	....	−60.8	....	32	N. 80° W.	12.3	
5 08.1	**17716**	57.2	**−61.6**	0.1	32	N. 77° W.	10.8	Balloon burst 5:09 p. m.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 22, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 42.5	312	749.2	1.4	....	40	N.	6.7	Cloudless.
....	500	....	− 0.8	....	39	N. 3° W.	6.6	
3 46.8	990	687.9	− 6.5	1.2	36	N. 10° W.	6.2	Inversion.
....	1000	....	− 6.4	....	36	N. 10° W.	6.2	
3 47.5	1091	....	− 5.7	−0.8	34	N. 6° W.	6.3	
3 49.2	1336	....	− 7.0	0.5	30	N. 4° E.	6.5	Inversion.
....	1500	....	− 5.7	....	27	N. 11° E.	6.7	
3 50.5	1524	642.5	− 5.5	−0.8	27	N. 12° E.	6.8	
....	2000	....	− 7.9	....	22	N. 33° E.	6.1	
3 55.5	2333	579.1	− 9.6	0.5	19	N. 48° E.	5.6	Inversion.
3 56.5	2489	....	− 8.5	−0.7	18	N. 49° E.	5.3	
3 57.8	2692	....	− 8.6	0.0	17	N. 50° E.	4.9	
3 59.8	3000	531.0	−10.3	0.6	16	N. 51° E.	4.3	
....	3500	....	−14.2	....	16	N. 57° E.	4.8	
4 03.0	3557	....	−14.7	0.8	16	N. 58° E.	4.9	
....	4000	....	−16.8	....	15	N. 63° E.	5.4	
4 06.2	4130	457.6	−17.4	0.5	15	N. 65° E.	5.5	
....	4500	....	−20.5	....	16	N. 72° E.	5.8	
....	5000	....	−24.6	....	17	N. 82° E.	6.2	
4 13.1	5331	388.7	−27.4	0.8	18	N. 88° E.	6.4	
....	6000	....	−29.8	....	18	N. 84° E.	8.3	
4 15.3	6176	....	−30.4	0.4	18	N. 83° E.	8.8	
4 16.2	6514	329.0	−35.4	1.5	18	N. 81° E.	9.8	
....	7000	....	−39.2	....	18	S. 89° E.	8.1	
....	8000	....	−46.9	....	18	S. 70° E.	7.2	
4 28.1	8305	252.9	−49.3	0.8	18	S. 64° E.	6.9	
....	9000	....	−53.3	....	17	S. 64° E.	7.9	
4 36.5	9864	199.1	−58.3	0.6	16	S. 64° E.	9.3	Inversion.
....	10000	....	−57.5	....	16	S. 45° E.	9.3	
4 42.5	10907	169.2	−52.3	−0.6	16	S. 79° W.	9.2	
....	11000	....	−52.3	....	16	S. 81° W.	9.7	
4 46.7	11771	148.5	−51.9	0.0	16	N. 81° W.	14.0	
....	12000	....	−52.3	....	16	N. 81° W.	14.4	
4 51.7	12981	123.4	−53.9	0.2	14	N. 82° W.	16.0	
....	13000	....	−53.9	....	14	N. 82° W.	16.0	
....	14000	....	−56.2	....	14	N. 77° W.	14.7	
4 55.9	14417	....	−57.1	0.2	15	N. 74° W.	14.1	Inversion.
4 56.2	14530	96.7	−56.4	−0.6	15	N. 74° W.	14.0	
4 59.0	14849	....	−58.0	0.5	14	N. 74° W.	12.8	
....	15000	....	−57.2	....	14	N. 73° W.	12.2	
5 02.6	15276	86.2	−55.8	−0.5	13	N. 73° W.	11.2	
5 08.0	15958	77.5	−56.3	0.1	13	N. 74° W.	10.8	
....	16000	....	−56.2	....	13	N. 74° W.	10.6	
5 15.1	10833	67.7	−53.8	−0.3	13	N. 65° W.	7.0	
....	17000	....	−54.0	....	13	N. 58° W.	7.1	
5 19.9	17755	58.5	−54.7	0.1	12	N. 25° W.	7.4	**Balloon burst.**

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 23, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 50.0	312	754.2	2.8	....	33	W.	4.0	Cloudless.
....	500	....	− 0.6	....	32	N. 80° W.	4.2	
....	1000	....	− 9.7	....	31	N. 63° W.	4.8	
3 53.4	1059	677.9	−10.8	1.8	31	N. 50° W.	4.9	Inversion.
3 55.8	1396	648.7	−10.2	−0.2	24	N. 39° W.	6.9	
....	1500	....	−10.5	....	23	N. 40° W.	6.7	
....	2000	....	−12.1	....	20	N. 43° W.	5.8	
....	2500	....	−13.7	....	17	N. 46° W.	5.0	
....	3000	....	−15.3	....	14	N. 50° W.	4.1	
4 05.2	3027	523.8	−15.4	0.3	14	N. 50° W.	4.1	
....	3500	....	−18.6	....	17	N. 24° W.	4.0	
....	4000	....	−22.0	....	20	N. 3° E.	4.0	
4 14.1	4494	429.6	−25.3	0.7	23	N. 30° E.	3.9	
4 15.2	4721	472.1	−25.9	0.3	23	N. 42° E.	7.3	
....	5000	....	−28.1	....	23	N. 46° E.	7.6	
4 21.9	5777	358.9	−34.4	0.8	23	N. 58° E.	8.6	
....	6000	....	−36.2	....	22	N. 61° E.	9.2	
....	7000	....	−44.3	....	20	N. 75° E.	12.0	
4 29.8	7068	297.3	−44.8	0.8	20	N. 76° E.	12.2	
4 31.7	7443	281.6	−46.1	0.3	20	N. 71° E.	18.5	
....	8000	....	−49.1	....	19	N. 70° E.	20.0	
4 36.6	8266	248.7	−50.6	0.5	19	N. 70° E.	20.7	
4 37.6	8508	239.6	−50.7	0.0	19	N. 59° E.	23.8	
4 39.9	8858	227.1	−52.6	0.5	20	N. 69° E.	23.7	
....	9000	....	−53.0	....	20	N. 69° E.	20.8	
4 43.0	9401	208.8	−54.0	0.3	20	N. 69° E.	12.3	Inversion.
....	10000	....	−53.5	....	21	N. 40° E.	8.6	
4 48.7	10462	177.7	−53.1	−0.1	21	N. 18° E.	5.8	
....	11000	....	−53.2	....	20	N. 21° W.	8.6	
....	11672	....	−53.3	....	19	N. 69° W.	12.2	
....	12000	....	−53.3	....	19	N. 63° W.	13.9	
4 59.7	12571	128.3	−53.4	0.0	18	N. 53° W.	17.0	
....	13000	....	−54.3	....	17	N. 55° W.	16.3	
....	14000	....	−56.4	....	15	N. 59° W.	14.6	
5 04.1	14104	101.1	−56.6	0.2	15	N. 60° W.	14.4	Inversion.
5 06.0	14409	96.5	−56.0	−0.2	15	N. 77° W.	17.5	
5 07.7	14810	90.6	−56.3	0.1	17	W.	14.8	Inversion.
....	15000	....	−55.9	....	17	N. 80° W.	16.1	
5 09.6	15360	83.0	−55.2	−0.2	18	N. 61° W.	18.6	
....	16000	....	−56.1	....	17	N. 45° W.	15.3	
5 13.2	16632	68.0	−57.0	0.1	16	N. 30° W.	12.1	Inversion.
....	17000	....	−56.4	....	16	N. 38° W.	10.8	
....	18000	....	−54.9	....	15	N. 61° W.	7.4	
5 22.3	18225	53.0	−54.5	−0.2	15	N. 66° W.	6.6	
5 27.4	18818	48.4	−55.3	0.1	15	N. 18° W.	9.3	Inversion.
....	19000	....	−54.9	....	15	N. 15° W.	10.7	
5 29.7	19671	41.0	−53.1	−0.2	15	N. 2° W.	17.3	Balloon burst.

TABLE X.—*Free air data by sounding balloons* (*September, 1909–March, 1911*)—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 24, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 51.0	312	736.2	11.0	....	20	S. 45° W.	5.4	Cloudless.
....	500	....	9.6	....	20	S. 45° W.	6.0	
....	1000	....	6.0	....	20	S. 47° W.	7.5	
....	1500	....	2.4	....	19	S. 49° W.	9.0	
3 56.6	1571	631.5	1.9	0.7	19	S. 49° W.	9.4	Inversion.
3 58.5	1846	610.5	3.0	−0.4	16	S. 67° W.	13.9	
....	2000	....	2.1	....	15	S. 64° W.	14.0	
....	2500	....	− 0.8	....	14	S. 60° W.	14.1	
....	3000	....	− 3.7	....	14	S. 55° W.	14.2	
....	3500	....	− 6.6	....	13	S. 50° W.	14.3	
4 07.9	3838	474.8	− 8.5	0.6	12	S. 48° W.	14.4	
....	4000	....	− 8.7	....	10	S. 49° W.	13.9	
4 09.9	4153	455.9	− 8.9	0.1	8	S. 50° W.	13.4	
....	4500	....	−11.3	....	8	S. 60° W.	14.5	
....	5000	....	−14.8	....	7	S. 72° W.	15.8	
4 17.3	5702	371.7	−19.7	0.7	7	S. 86° W.	17.1	
....	6000	....	−21.6	....	7	S. 83° W.	16.9	
4 22.0	6689	....	−25.9	....	6	S. 76° W.	16.7	Balloon disappeared.
....	7000	....	−27.9	....	5	....	....	
4 25.4	7381	295.2	−30.3	0.6	5	....	....	
....	8000	....	−33.0	....	5	....	....	
....	9000	....	−37.4	....	4	....	....	
4 33.5	9255	226.4	−38.5	0.4	4	....	....	
....	10000	....	−40.5	....	4	....	....	
....	11000	....	−43.2	....	3	....	....	
4 42.9	11370	166.0	−44.8	0.3	3	....	....	Inversion.
....	12000	....	−43.8	....	3	....	....	
4 46.0	12165	147.6	−43.1	−0.2	3	....	....	
4 48.0	12815	137.3	−43.3	0.0	3	....	....	Inversion.
....	13000	....	−42.2	....	3	....	....	
4 49.4	13094	128.4	−41.6	−0.6	3	....	....	
4 50.4	13196	126.7	−42.8	1.2	3	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 25, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 31.5	312	722.8	11.2	....	14	S. 22° W.	5.4	10/10 St.-Cu. WSW.
....	500	....	8.4	....	14	S. 24° W.	6.3	
....	1000	....	1.0	....	15	S. 30° W.	8.6	
3 36.9	1406	631.5	− 5.0	1.5	16	S. 35° W.	10.5	Inversion.
....	1500	....	− 3.1	....	15	S. 46° W.	9.9	
3 38.9	1771	603.2	2.3	−2.0	13	S. 77° W.	8.1	
....	2000	....	0.6	....	14	S. 74° W.	8.6	
....	2500	....	− 3.2	....	15	S. 68° W.	9.6	
....	3000	....	− 6.9	....	17	S. 61° W.	10.5	
3 47.0	3180	....	− 8.3	....	17	S. 59° W.	10.9	Balloon in clouds 3:47 p. m.
....	3500	....	−10.7	....	18	....	....	
3 50.0	3694	472.4	−12.1	0.7	19	....	....	
....	4000	....	−13.6	....	18	....	....	
3 52.1	4048	451.2	−13.8	0.5	18	....	....	
....	4500	....	−16.7	....	17	....	....	
....	5000	....	−19.9	....	16	....	....	
3 59.4	5264	383.6	−21.6	0.6	15	....	....	
4 01.5	5584	366.9	−22.3	0.2	15	....	....	
....	6000	....	−26.5	....	15	....	....	
....	7000	....	−33.3	....	15	....	....	
4 12.5	7699	272.9	−38.7	0.8	15	....	....	
....	8000	....	−40.0	....	15	....	....	
....	9000	....	−44.4	....	14	....	....	
4 21.1	9521	208.8	−46.7	0.4	14	....	....	Inversion.
....	10000	....	−46.1	....	14	....	....	
4 25.2	10464	181.4	−45.5	−0.1	14	....	....	
4 27.2	10908	....	−45.4	0.0	13	....	....	
4 29.7	11459	156.6	−44.9	−0.1	13	....	....	
....	12000	....	−44.7	....	13	....	....	
4 32.6	12051	....	−44.7	0.0	13	....	....	
4 34.2	12372	136.4	−45.0	0.1	13	....	....	
....	13000	....	−45.3	....	13	....	....	
....	14000	....	−45.9	....	13	....	....	
4 38.8	14242	103.3	−46.0	0.1	13	....	....	
....	15000	....	−46.4	....	13	....	....	
4 44.9	15611	84.1	−46.7	0.1	13	....	....	
4 47.1	16003	79.2	−47.4	0.2	10	....	....	Inversion.
....	17000	....	−47.3	....	10	....	....	
....	18000	....	−47.2	....	10	....	....	
4 55.1	18259	....	−47.2	0.0	10	....	....	
....	19000	....	−47.2	....	10	....	....	
4 59.7	19563	46.5	−47.2	0.0	10	....	....	
....	20000	....	−47.0	....	10	....	....	
5 02.4	20130	....	−46.9	−0.1	10	....	....	
5 05.6	20802	....	−46.8	0.0	10	....	....	
....	21000	....	−46.6	....	10	....	....	
5 08.8	21458	35.0	−46.2	−0.1	10	....	....	
....	22000	....	−46.1	....	10	....	....	
....	23000	....	−46.0	....	9	....	....	
....	24000	....	−45.8	....	9	....	....	
5 17.6	24105	23.5	−45.8	0.0	9	....	....	

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 26, 1911.

Time.	Altitude.	Pressure.	Temperature.	Δt/100 m.	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
4 05.0	312	741.3	0.0	....	39	N.	9.8	Cloudless.
....	500	....	− 2.5	....	41	N. 1° E.	10.1	
....	1000	....	− 9.1	....	45	N. 5° E.	11.0	
4 11.7	1426	642.4	−14.7	1.3	49	N. 8° E.	11.8	Inversion.
....	1500	....	−13.3	....	44	N. 3° E.	10.8	
4 12.8	1611	....	−11.2	−1.9	37	N. 4° W.	9.4	
4 14.1	1826	609.7	−11.4	0.1	22	N. 17° W.	6.6	
....	2000	....	−12.5	....	23	N. 23° W.	6.6	
4 16.8	2263	....	−14.2	0.6	25	N. 32° W.	6.5	
....	2500	....	−15.3	....	27	N. 40° W.	6.4	
4 18.8	2583	551.9	−15.7	0.5	28	N. 43° W.	6.4	Inversion.
4 19.4	2680	....	−15.5	−0.2	29	N. 48° W.	7.2	
....	3000	....	−16.6	....	31	N. 64° W.	9.8	
4 23.7	3374	496.7	−17.9	0.3	33	N. 83° W.	12.8	
....	3500	....	−18.7	....	32	N. 86° W.	13.9	
....	4000	....	−21.9	....	30	S. 83° W.	18.2	
4 29.0	4375	433.6	−24.3	0.6	28	S. 75° W.	21.4	
....	4500	....	−25.3	....	28	S. 74° W.	21.7	
4 32.9	5009	397.2	−29.2	0.8	26	S. 73° W.	23.1	
....	6000	....	−36.6	....	27	S. 75° W.	19.6	
4 38.1	6048	342.9	−37.0	0.8	27	S. 75° W.	19.4	
4 42.6	6816	306.6	−39.2	0.3	23	S. 83° W.	34.3	Balloon disappeared 4:43 p. m.
....	7000	....	−40.5	....	23	....	....	
4 45.8	7507	....	−44.0	0.7	22	....	....	
....	8000	....	−45.9	....	21	....	....	
4 48.7	8134	....	−46.4	0.4	21	....	....	
4 50.9	8620	235.0	−47.1	0.1	20	....	....	
....	9000	....	−48.8	....	20	....	....	
....	10000	....	−53.4	....	19	....	....	
4 57.8	10031	189.6	−53.5	0.5	19	....	....	
4 59.7	10441	....	−53.8	0.1	18	....	....	Inversion.
5 02.2	10981	....	−50.9	−0.5	17	....	....	
....	11000	....	−50.9	....	17	....	....	
5 04.4	11469	152.5	−51.7	0.2	16	....	....	Inversion.
....	12000	....	−49.8	....	16	....	....	
5 09.9	12690	126.5	−47.4	−0.4	16	....	....	
....	13000	....	−47.9	....	15	....	....	
5 12.4	13485	....	−48.6	0.2	14	....	....	
....	14000	....	−50.5	....	13	....	....	
5 17.0	14958	89.3	−54.0	0.4	11	....	....	
....	15000	....	−54.6	....	11	....	....	
5 18.4	15428	....	−54.0	0.0	11	....	....	
5 19.2	15697	....	−54.9	0.3	11	....	....	
5 19.6	15832	....	−54.5	−0.3	11	....	....	Inversion.
....	16000	....	−54.4	....	12	....	....	
5 22.5	16801	67.1	−53.9	−0.1	12	....	....	
....	17000	....	−54.2	....	12	....	....	
....	18000	....	−55.6	....	12	....	....	
5 26.9	18306	....	−56.0	0.1	11	....	....	Inversion.
....	19000	....	−55.2	....	11	....	....	
5 30.1	19380	44.9	−54.7	−0.1	11	....	....	
....	20000	....	−54.5	....	11	....	....	
....	21000	....	−54.3	....	10	....	....	
5 36.7	21601	31.8	−54.1	0.0	10	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 27, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 55.0	312	749.0	− 5.0	....	35	N.	5.8	10/10 A.-St. W.
....	500	....	− 8.2	....	35	N. 4° E.	6.6	
....	1000	....	−16.7	....	35	N. 14° E.	8.6	
3 59.1	1072	678.3	−17.9	1.7	35	N. 15° E.	8.9	Inversion.
....	1500	....	−14.1	....	35	N. 20° E.	5.1	
4 01.7	1527	638.7	−13.9	−0.9	35	N. 20° E.	4.9	
....	2000	....	−16.2	....	37	N. 17° W.	3.7	
4 06.0	2134	589.3	−16.8	0.5	37	N. 27° W.	3.3	Inversion.
....	2500	....	−16.0	....	38	N. 62° W.	5.4	
4 10.1	2799	539.4	−15.4	−0.2	39	S. 88° W.	7.2	
....	3000	....	−16.3	....	40	S. 86° W.	10.2	
4 13.1	3231	....	−17.4	0.5	41	S. 84° W.	13.7	Inversion.
....	3500	....	−16.5	....	42	S. 82° W.	17.7	
4 15.3	3561	487.5	−16.3	−0.3	42	S. 81° W.	18.6	
....	4000	....	−19.9	....	41	S. 81° W.	21.4	
....	4500	....	−23.9	....	41	S. 82° W.	24.7	
4 23.4	4878	407.6	−27.0	0.8	40	S. 82° W.	27.1	Balloon in clouds 4:25 p. m.
....	5000	....	−27.1	....	40	....	....	
4 26.3	5383	....	−27.6	0.1	41	....	....	
4 28.3	5731	....	−30.0	0.7	42	....	....	
4 29.4	5915	352.7	−30.4	0.2	42	....	....	
....	6000	....	−30.9	....	42	....	....	
....	7000	....	−36.9	....	41	....	....	
4 36.2	7100	297.8	−37.5	0.6	41	....	....	
....	8000	....	−44.1	....	41	....	....	
4 43.0	8465	243.8	−47.5	0.7	41	....	....	
....	9000	....	−50.1	....	40	....	....	
4 47.9	9217	217.1	−51.7	0.6	39	....	....	
4 50.9	9919	....	−56.3	0.7	38	....	....	
....	10000	....	−56.5	....	38	....	....	
4 52.0	10180	187.0	−56.8	0.2	38	....	....	
....	11000	....	−60.5	....	38	....	....	
4 56.4	11324	157.0	−61.9	0.4	38	....	....	Inversion.
....	12000	....	−61.2	....	39	....	....	
....	13000	....	−60.3	....	40	....	....	
5 05.9	13373	113.2	−59.9	−0.1	40	....	....	
5 06.7	13618	....	−58.8	−0.4	40	....	....	
....	14000	....	−58.9	....	39	....	....	
5 10.5	14781	....	−59.2	0.0	39	....	....	
....	15000	....	−59.7	....	38	....	....	
....	16000	....	−62.0	....	37	....	....	
5 15.4	16268	71.3	−62.6	0.2	37	....	....	Inversion.
....	17000	....	−60.9	....	37	....	....	
5 20.6	17391	....	−60.0	−0.2	37	....	....	
5 20.8	17450	59.0	−58.8	−2.0	37	....	....	
5 22.2	17710	....	−60.2	0.5	38	....	....	
....	18000	....	−58.0	....	39	....	....	
5 24.4	18122	52.9	−57.1	−0.8	40	....	....	
5 26.0	18487	....	−58.8	0.5	39	....	....	
....	19000	....	−58.9	....	38	....	....	
5 30.9	19597	41.9	−59.0	0.0	37	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

FEBRUARY 28, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\ m.}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*° C.*		*Per cent.*		*m. p. s.*	
3 48.0	312	747.0	− 0.8	....	26	S. 22° W.	1.3	10/10 A.-St. W.
....	500	....	− 2.5	....	27	S. 23° W.	1.2	
....	1000	....	− 7.2	....	29	S. 27° W.	1.1	
3 53.1	1275	660.7	− 9.7	0.9	30	S. 29° W.	1.0	Inversion.
....	1500	....	− 9.3	....	30	S. 38° W.	2.1	
3 55.6	1770	....	− 8.9	−0.2	29	S. 48° W.	3.3	
3 56.8	1999	601.6	− 9.9	0.4	29	S. 57° W.	4.4	Inversion.
....	2500	....	− 8.6	....	....	S. 72° W.	7.6	
....	3000	....	− 7.3	....	....	S. 88° W.	10.8	
4 02.7	3102	521.8	− 7.0	−0.3	....	N. 89° W.	11.5	
....	3500	....	− 8.4	....	....	N. 87° W.	13.2	
....	4000	....	−10.1	....	....	N. 84° W.	15.4	
4 10.8	4491	435.9	−11.8	0.3	....	N. 82° W.	17.6	
....	5000	....	−14.3	....	....	N. 82° W.	22.3	
4 17.0	5607	....	−16.8	....	....	N. 81° W.	28.0	Balloon disappeared on account of smoke near surface.
....	6000	....	−19.3	....	....	....	....	
....	7000	....	−24.2	....	....	....	....	
4 25.6	7196	303.1	−25.2	0.5	49	....	....	
....	8000	....	−31.3	....	48	....	....	
4 32.8	8605	248.8	−36.0	0.8	48	....	....	
4 33.3	8704	....	−36.0	0.0	48	....	....	
....	9000	....	38.7	....	47	....	....	
4 36.9	9415	221.2	−42.3	0.9	46	....	....	
4 37.9	9619	....	−42.3	0.0	46	....	....	
....	10000	....	−45.0	....	46	....	....	
4 40.1	10064	201.1	−45.5	0.7	46	....	....	
4 43.3	10781	180.4	−51.6	0.9	46	....	....	
....	11000	....	−51.8	....	46	....	....	
4 44.2	11078	....	−51.9	0.1	46	....	....	
4 45.6	11540	....	−53.9	0.4	46	....	....	
....	12000	....	−55.8	....	46	....	....	
4 47.2	12076	147.9	−56.1	0.4	46	....	....	
4 51.8	12890	130.2	−57.4	0.2	46	....	....	Inversion.
....	13000	....	−57.3	....	46	....	....	
....	14000	....	−56.7	....	45	....	....	
4 56.7	14369	103.5	−56.5	−0.1	45	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

MARCH 2, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 37.0	312	731.0	12.2	....	28	W.	4.9	2/10 Cl. WNW.
....	500	....	10.4	....	28	W	5.8	
....	1000	....	5.6	....	28	W.	7.5	
3 42.9	1337	645.6	2.3	1.0	28	N. 87° W.	8.7	
....	1500	....	1.5	....	29	N. 85° W.	9.5	
....	2000	....	− 0.9	....	30	N. 80° W.	10.5	
....	2500	....	− 3.3	....	31	N. 75° W.	11.5	
3 50.5	2570	553.1	− 3.6	0.5	31	N. 72° W.	11.9	
....	3000	....	− 6.5	....	31	N. 68° W.	13.0	
3 53.3	3111	516.3	− 7.2	0.7	31	N. 67° W.	13.6	
....	3500	....	− 8.8	....	33	N. 56° W.	16.0	
3 56.5	3732	476.7	− 9.8	0.4	34	N. 50° W.	17.2	
....	4000	....	−11.6	....	35	N. 55° W.	16.5	
3 59.6	4404	436.5	−14.4	0.7	36	N. 63° W.	15.6	
....	4500	....	−14.9	....	36	N. 61° W.	15.2	
4 02.5	5017	402.6	−17.7	0.5	36	N. 56° W.	14.5	
....	6000	....	−25.4	....	37	N. 50° W.	16.0	
4 07.4	6187	343.4	−26.9	0.8	37	N. 49° W.	16.4	
....	7000	....	−31.7	....	36	N. 53° W.	17.0	
....	8000	....	−37.6	....	35	N. 58° W.	18.0	
4 17.6	8345	253.2	−39.7	0.6	34	N. 60° W.	18.5	Balloon in clouds.
....	9000	....	−46.2	....	34	....	....	
4 23.8	9713	206.9	−45.8	0.4	34	....	....	
....	10000	....	−46.3	....	33	....	....	
....	11000	....	−47.9	....	32	....	....	
4 30.2	11143	167.0	−48.1	0.2	32	....	....	Inversion.
....	12000	....	−47.0	....	33	....	....	
4 37.5	12683	132.4	−46.2	−0.1	34	....	....	
4 39.0	12968	126.8	−47.3	0.4	33	....	....	Inversion.
....	13000	....	−47.1	....	33	....	....	
4 40.8	13690	113.8	−46.6	−0.1	33	....	....	
....	14000	....	−47.0	....	33	....	....	
4 45.1	15058	92.8	−48.5	0.1	32	....	....	Inversion.
....	16000	....	−48.2	....	32	....	....	
4 50.3	16377	75.8	−48.1	0.0	32	....	....	
....	17000	....	−47.6	....	32	....	....	
4 54.7	17493	64.4	−47.3	−0.1	32	....	....	
....	18000	....	−47.5	....	32	....	....	
4 59.3	18453	55.9	−47.6	0.0	32	....	....	Inversion.
5 02.5	18861	52.6	−45.4	−0.5	31	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909–March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

MARCH 3, 1911.

Time.	Altitude.	Pressure.	Temperature.	$\frac{\Delta t}{100\text{ m.}}$	Relative humidity.	Wind.		Remarks.
						Direction.	Velocity.	
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 54.5	312	735.0	7.5	....	47	N.	5.8	2/10 Ci. WNW. Few Cu. NW.
....	500	....	5.7	....	49	N. 2° W.	5.7	
....	1000	....	0.9	....	54	N. 9° W.	5.3	
....	1500	....	− 3.9	....	59	N.15° W.	4.9	
3 59.9	1512	633.3	− 4.0	1.0	59	N.15° W.	4.9	
....	2000	....	− 4.1	....	58	N.47° W.	8.5	
4 04.8	2206	575.5	− 4.1	0.0	58	N.65° W.	10.4	
....	2500	....	− 5.8	....	59	N.67° W.	11.8	
....	3000	....	− 9.5	....	62	N.71° W.	14.8	
4 10.6	3291	504.5	−11.6	0.7	63	N.73° W.	16.5	
....	3500	....	−12.5	....	63	N.73° W.	17.8	
....	4000	....	−14.8	....	65	N.72° W.	20.9	
4 16.0	4202	447.7	−15.7	0.5	65	N.72° W.	22.1	
....	4500	....	−17.9	....	64	N.72° W.	22.0	
....	5000	....	−21.4	....	62	N.72° W.	22.0	
4 25.1	5886	356.2	−27.8	0.7	59	N.72° W.	21.8	
....	6000	....	−28.8	....	59	N.72° W.	22.3	
4 29.7	6742	315.9	−35.1	0.9	56	N.69° W.	25.7	
....	7000	....	−35.9	....	54	N.69° W.	31.0	
4 32.2	7148	298.1	−36.3	0.3	53	N.69° W.	34.1	Balloon in clouds 4:34 p. m.
4 36.6	7986	264.0	−40.3	0.5	53	....	....	
....	8000	....	−40.4	....	53	....	....	
....	9000	....	−47.3	....	52	....	....	
4 43.7	9409	213.8	−50.1	0.7	52	....	....	
4 45.6	9838	200.3	−51.9	0.4	51	....	....	
....	10000	....	−52.3	....	51	....	....	
4 48.2	10279	186.9	−53.0	0.2	51	....	....	
....	11000	....	−53.3	....	51	....	....	
4 55.0	11998	143.7	−53.7	0.0	51	....	....	
....	13000	....	−53.9	....	50	....	....	
4 58.7	13055	122.0	−53.9	0.0	50	....	....	
....	14000	....	−53.9	....	50	....	....	
....	15000	....	−53.9	....	50	....	....	
....	16000	....	−53.9	....	50	....	....	
....	17000	....	−53.9	....	50	....	....	
....	18000	....	−53.9	....	50	....	....	
5 23.9	19050	48.4	−53.9	0.0	50	....	....	Balloon burst.

TABLE X.—*Free air data by sounding balloons (September, 1909-March, 1911)*—Contd.

FOURTH SERIES, OMAHA—Continued.

MARCH 4, 1911.

Time.	Altitude.	Pressure.	Temperature.	Δt / 100 m.	Relative humidity.	Wind. Direction.	Wind. Velocity.	Remarks.
p. m. *h. m.*	*m.*	*mm.*	*°C.*		*Per cent.*		*m. p. s.*	
3 39.0	312	740.8	5.4	....	42	S. 45° E.	4.0	Few Ci. W:
....	500	....	3.6	....	43	S. 43° E.	4.7	
....	1000	....	− 1.1	....	44	S. 39° E.	6.4	
3 42.7	1299	655.2	− 4.0	1.0	45	S. 36° E.	7.5	Inversion.
....	1500	....	− 3.0	....	46	S. 20° E.	8.7	
3 45.3	1793	615.6	− 1.4	−0.5	48	S. 4° W.	10.5	
....	2000	....	− 1.6	....	49	S. 30° W.	10.2	
3 47.8	2262	580.4	− 1.9	0.1	50	S. 62° W.	9.9	
....	2500	....	− 3.9	....	51	S. 64° W.	11.6	
3 51.8	2953	531.5	− 7.6	0.8	53	S. 68° W.	14.9	
....	3000	....	− 7.7	....	53	S. 69° W.	15.4	
....	3500	....	− 9.1	....	56	S. 82° W.	20.7	
3 54.8	3573	490.6	− 9.3	0.3	56	S. 84° W.	21.5	
....	4000	....	−12.2	....	60	S. 83° W.	21.0	
3 58.4	4299	446.2	−14.2	0.7	62	S. 82° W.	20.6	
....	4500	....	−14.9	....	62	S. 88° W.	21.0	
4 01.7	4925	410.8	−16.4	0.4	63	N. 78° W.	21.7	Balloon disappeared 4:08 p. m. in haze.
4 02.1	5000	....	−17.1	....	63	N. 74° W.	27.5	
4 07.4	6000	....	−26.1	....	62	N. 76° W.	29.6	
....	7000	....	−35.0	....	62	....	....	
4 14.7	7398	291.6	−38.6	0.9	61	....	....	
....	8000	....	−43.8	....	60	....	....	
4 20.5	8603	244.2	−49.0	0.9	58	....	....	
....	9000	....	−50.3	....	57	....	....	
4 26.7	9973	198.2	−53.7	0.3	56	....	....	
....	11000	....	−53.8	....	55	....	....	
4 32.5	11371	160.0	−53.9	0.0	55	....	....	Inversion.
....	12000	....	−53.7	....	55	....	....	
....	13000	....	−53.4	....	55	....	....	
4 38.3	13235	119.9	−53.3	0.0	55	....	....	
....	14000	....	−53.6	....	55	....	....	
4 40.8	14203	103.7	−53.7	0.0	55	....	....	Inversion.
4 42.9	15058	91.0	−53.5	0.0	55	....	....	
....	16000	....	−53.8	....	55	....	....	
4 46.0	16196	76.2	−53.9	0.0	55	....	....	Inversion.
....	17000	....	−53.7	....	55	....	....	
4 50.3	17575	61.5	−53.5	0.0	55	....	....	Balloon burst.

END OF TABLE X.

CORRIGENDA.

Vol. 4, page 125, line 15, July 29 for "1909" read "1908."

Vol. 4, page 125, lines 27 and 28, after line 27, "Sept. 30, 1908," set the 5 lines "Nov. 7, 1901," to "Nov. 6, 1907," lower down and insert the caption

"FALL (OCTOBER AND NOVEMBER), MANNED BALLOONS."

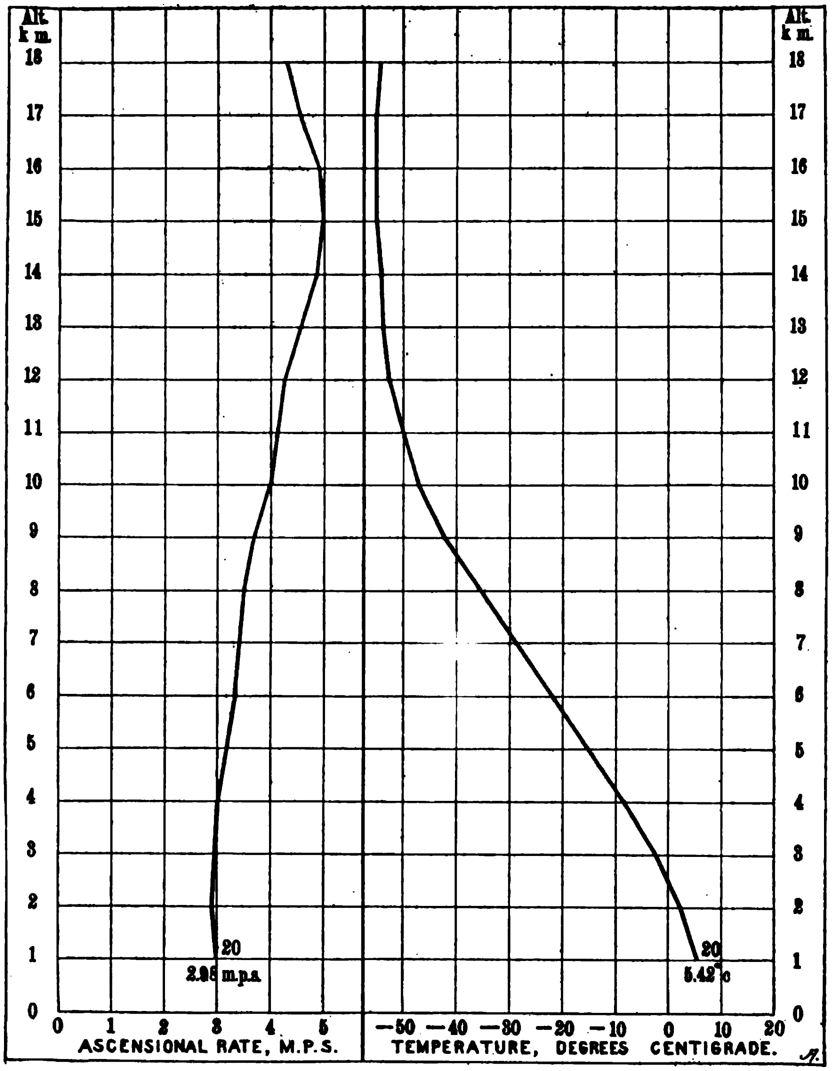

FIG. 1.—Relation between ascensional rate of balloons and air temperatures.

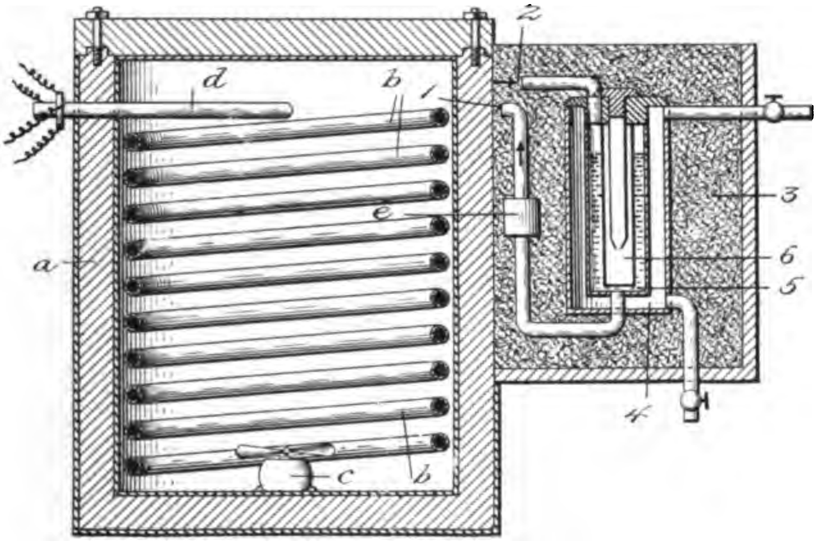

FIG. 2.—Calibrating chamber and cooling device.

(a) White pine, lined inside and out with bright tin.
(b) Pipes through which alcohol circulates.
(c) Fan motor and fan.
(d) Thermometer.
(e) Pump which keeps alcohol in circulation.
(1) Into inside system of tubing.
(2) From inside system of tubing.
(3) Packing of hair felt.
(4) Vapor of liquid air.
(5) Alcohol and stirrers.
(6) Liquid air.

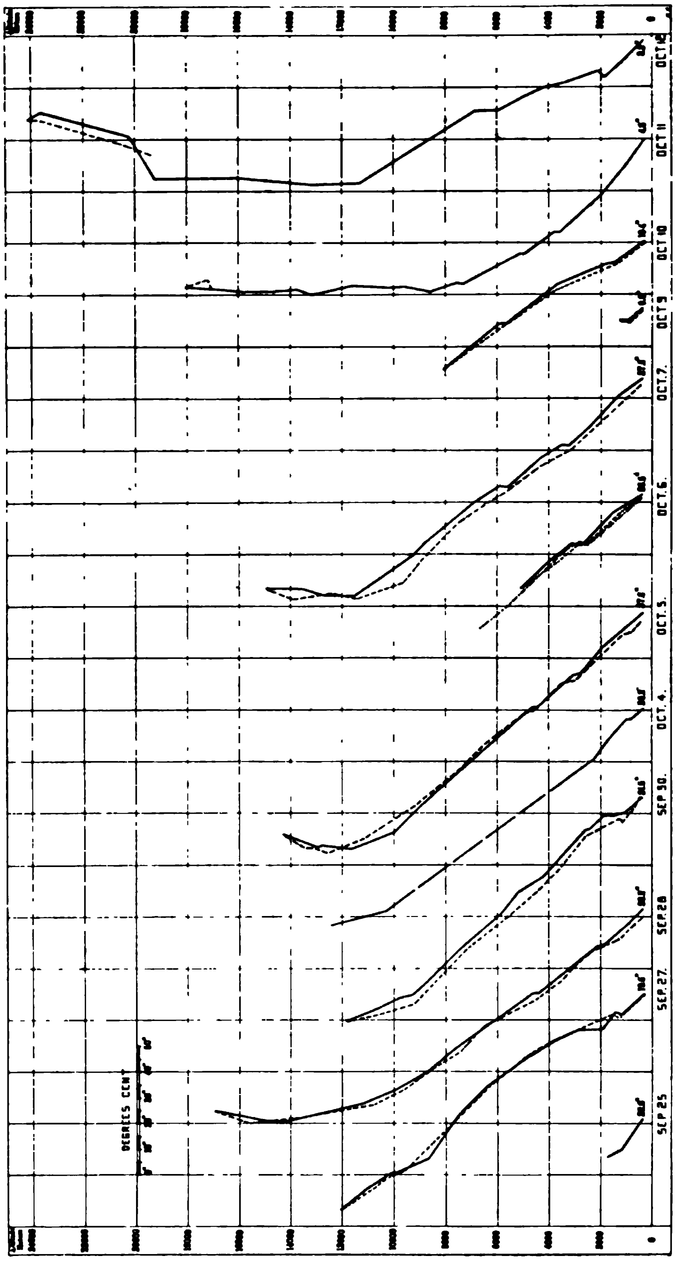

FIG. 3.—Vertical temperature gradients as observed at Omaha, Sept. 25 to Oct. 12, 1909.

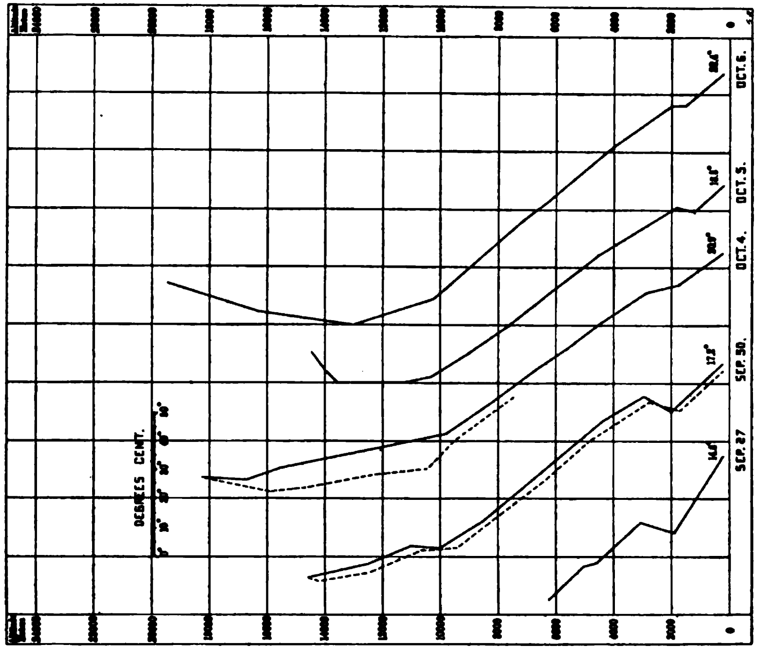

FIG. 4.—Vertical temperature gradients as observed at Indianapolis, Sept. 27 to Oct. 6, 1909.

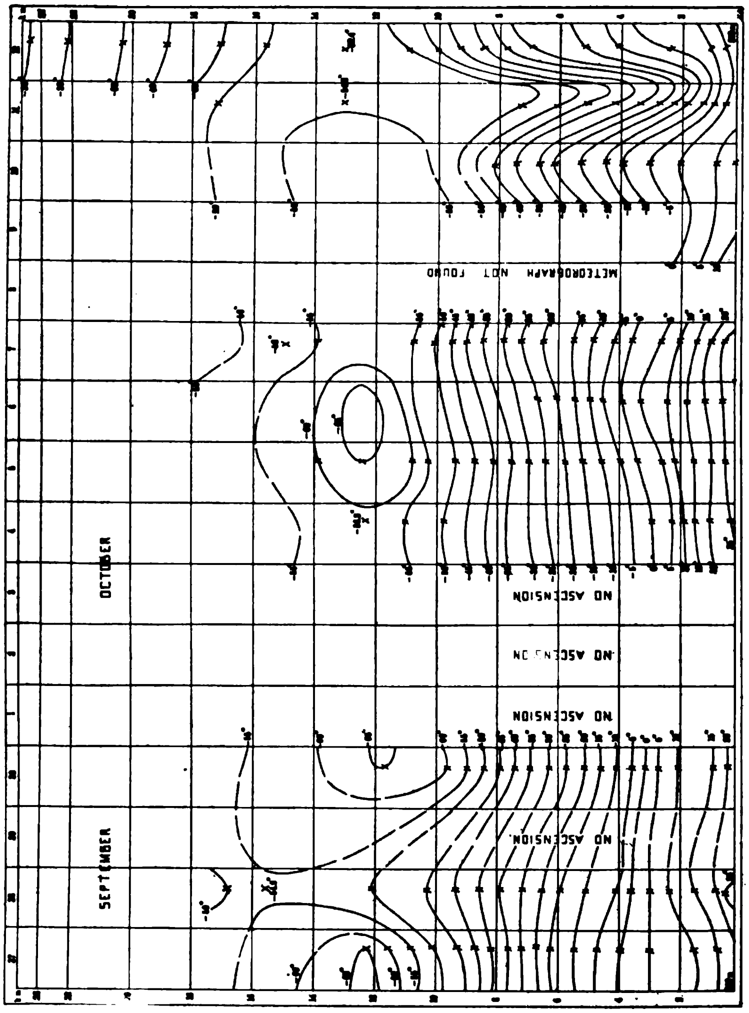

FIG. 5.—Free air isotherms over Omaha, Sept. 27 to Oct. 12, 1909.

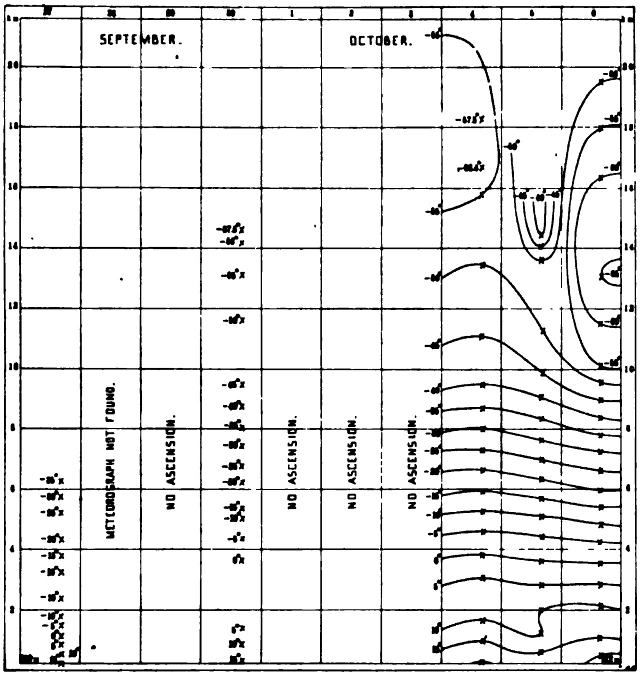

FIG. 6.—Free air isotherms over Indianapolis, Sept. 27 to Oct. 6, 1909.

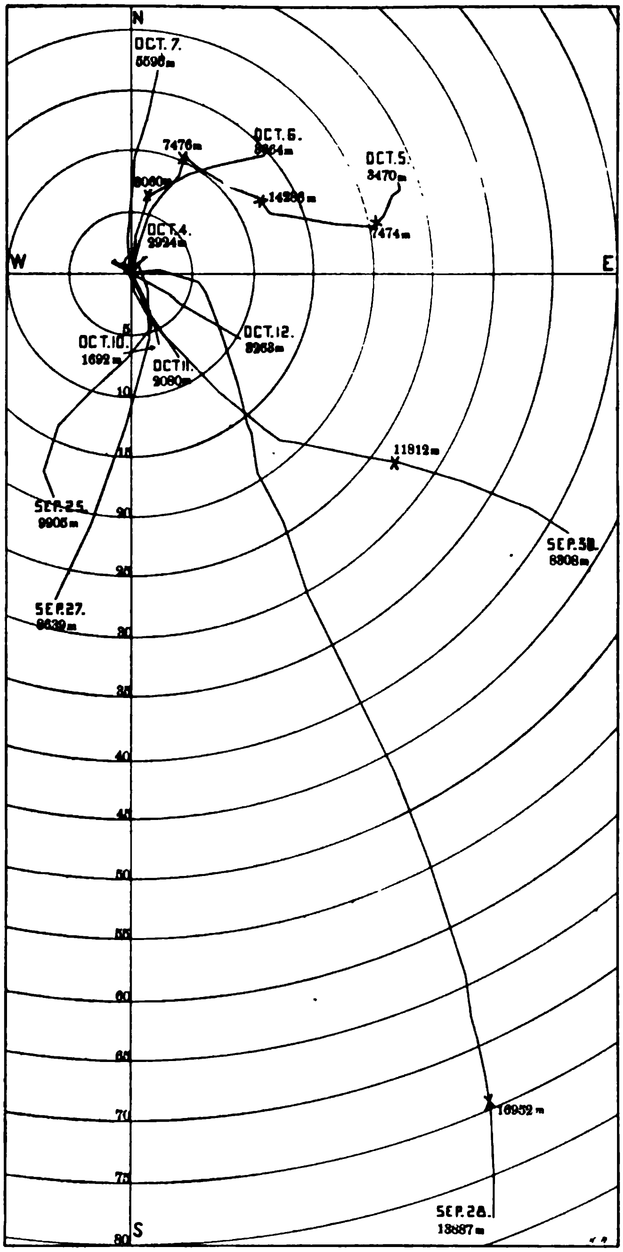

FIG. 7.—Horizontal projections of the paths of the balloons set free at Omaha, Sept. 25 to Oct. 12, 1909.

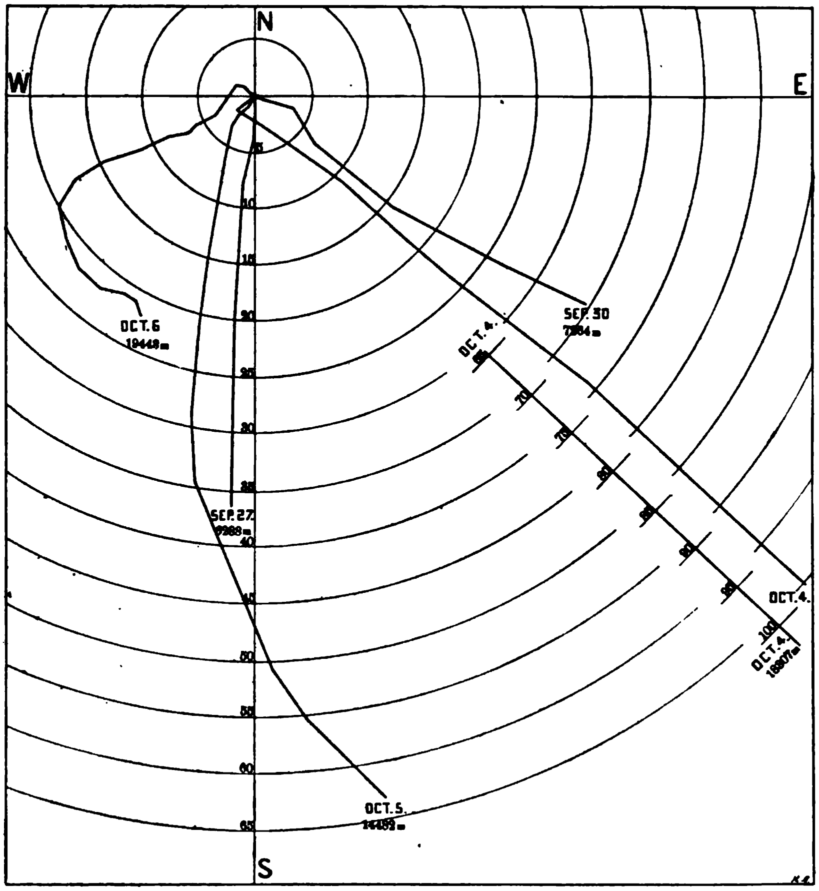

FIG. 8.—Horizontal projections of the paths of the balloons set free at Indianapolis, Sept. 27 to Oct. 6, 1909.

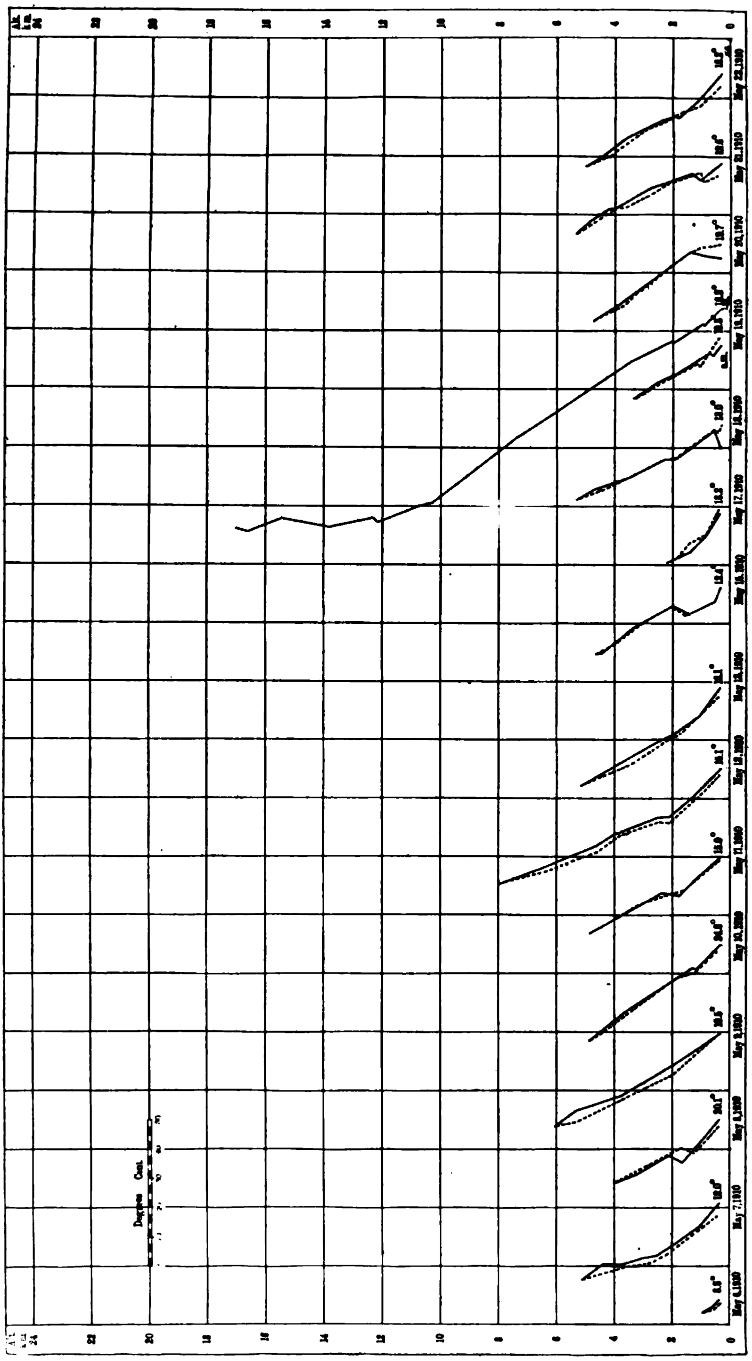

FIG. 9.—Vertical temperature gradients as observed at Omaha, May 6–22, 1910.

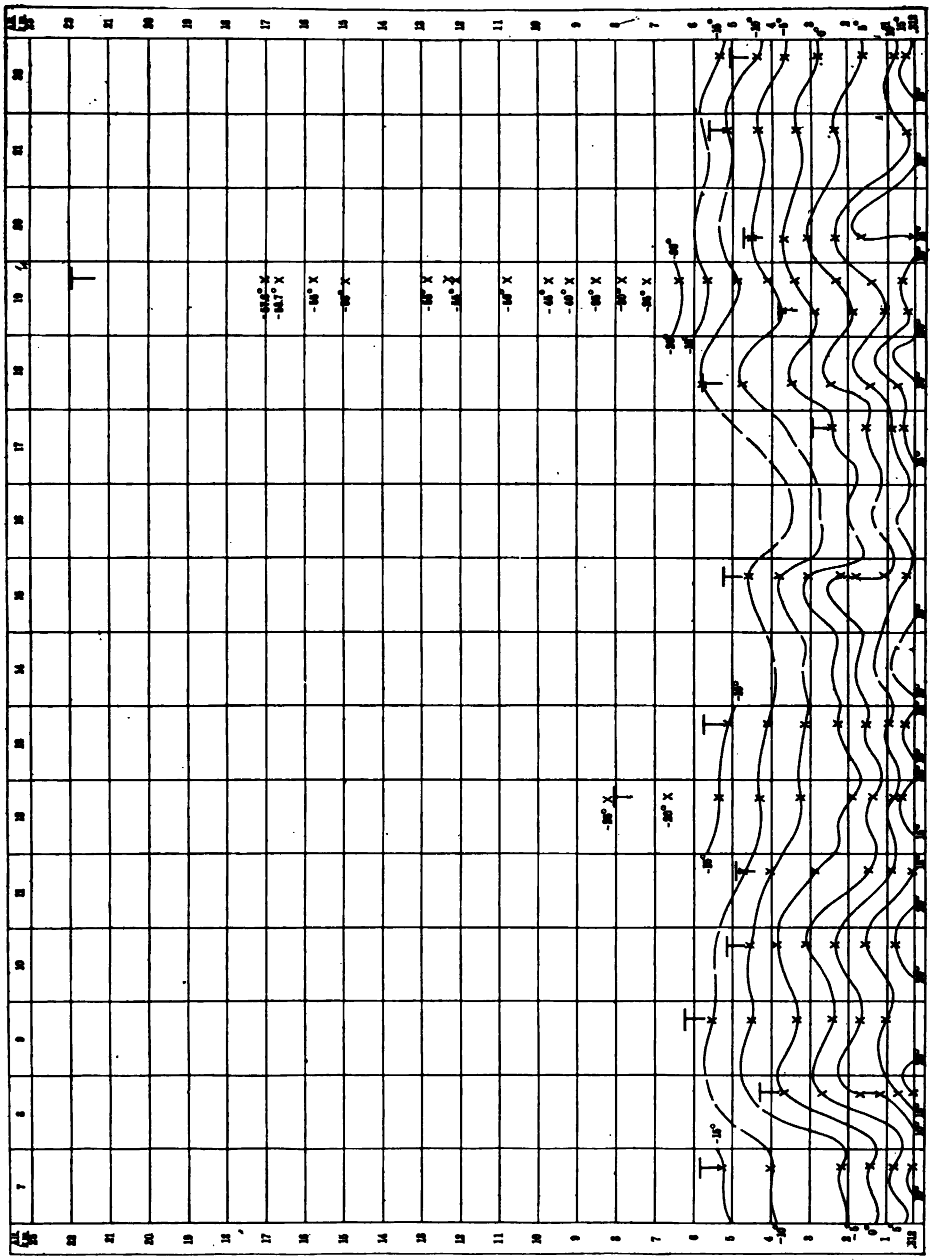

Fig. 10.—Free air isotherms over Omaha, May 7-22, 1910.

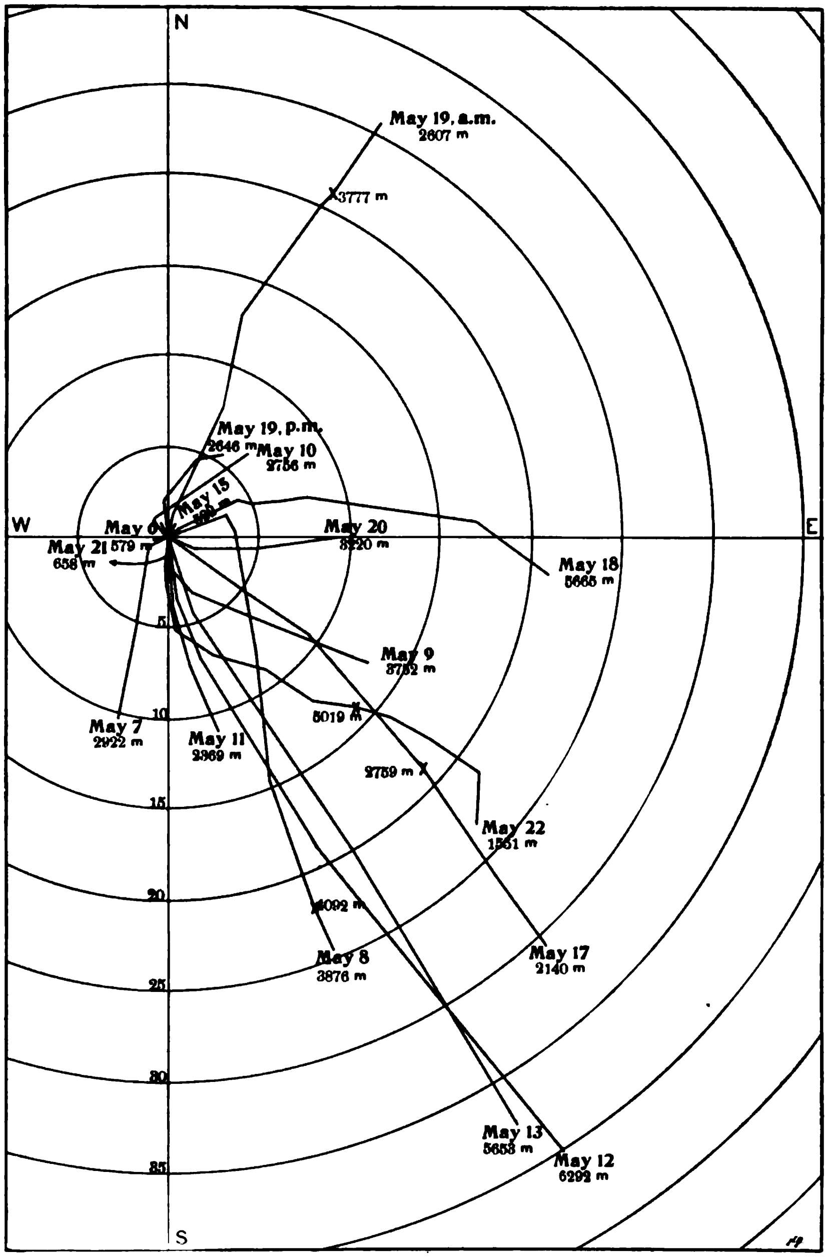

FIG. 11. Horizontal projections of the paths of the balloons set free at Omaha, May 6–22, 1910.

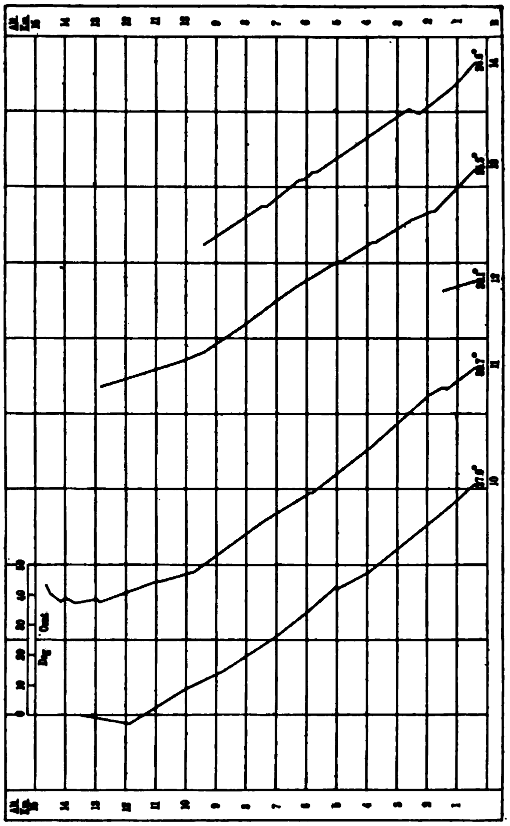

FIG. 12A.—Vertical temperature gradients as observed at Huron, Aug. 10-14, 1910.

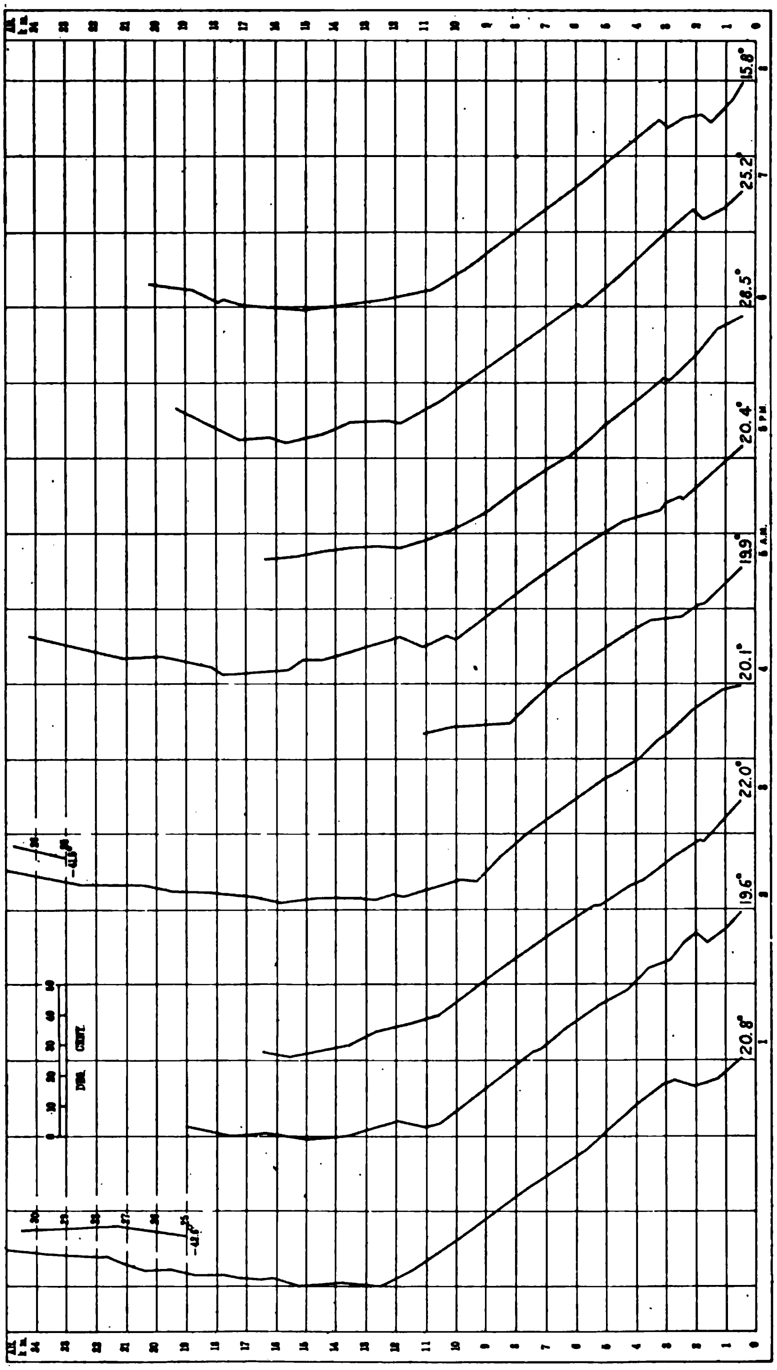

FIG. 12B.—Vertical temperature gradients as observed at Huron, Sept. 1-8, 1910.

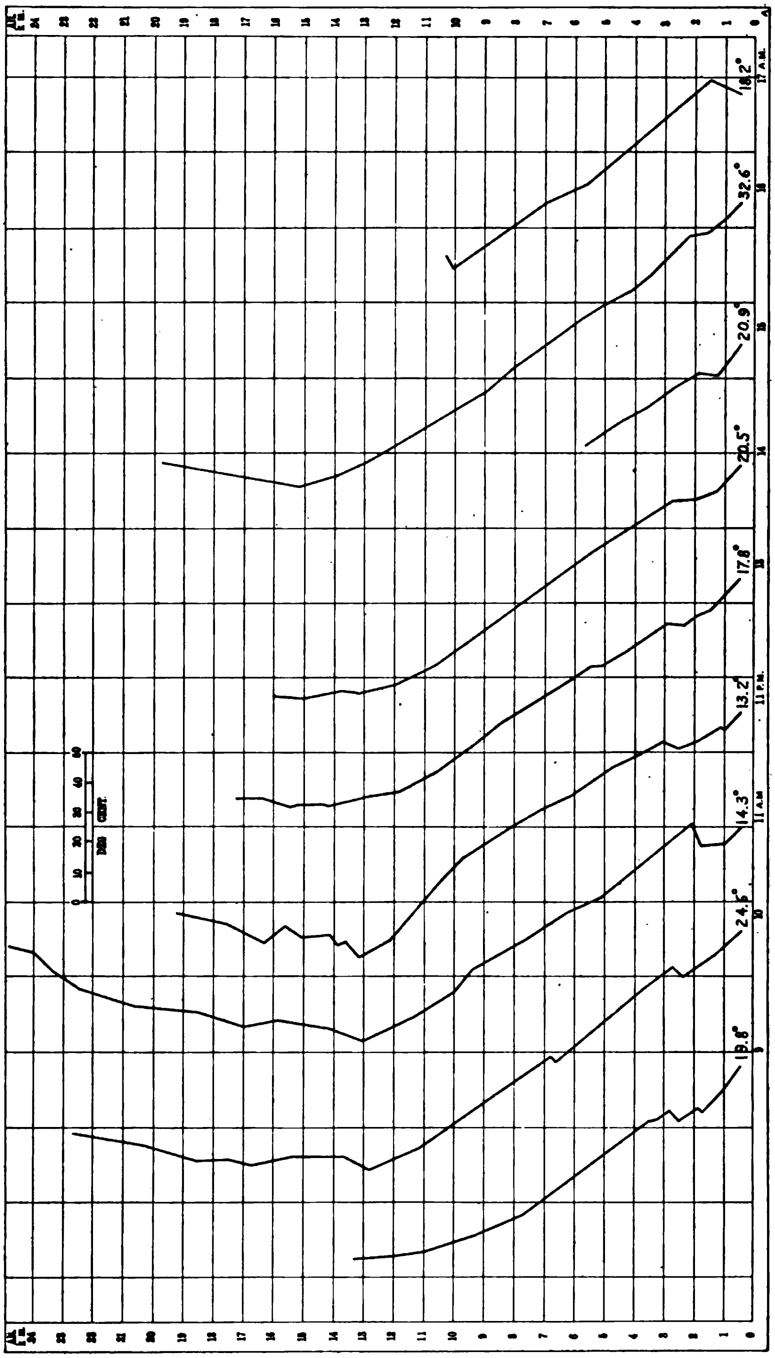

FIG. 12C.—Vertical temperature gradients as observed at Huron, Sept. 9-17, 1910.

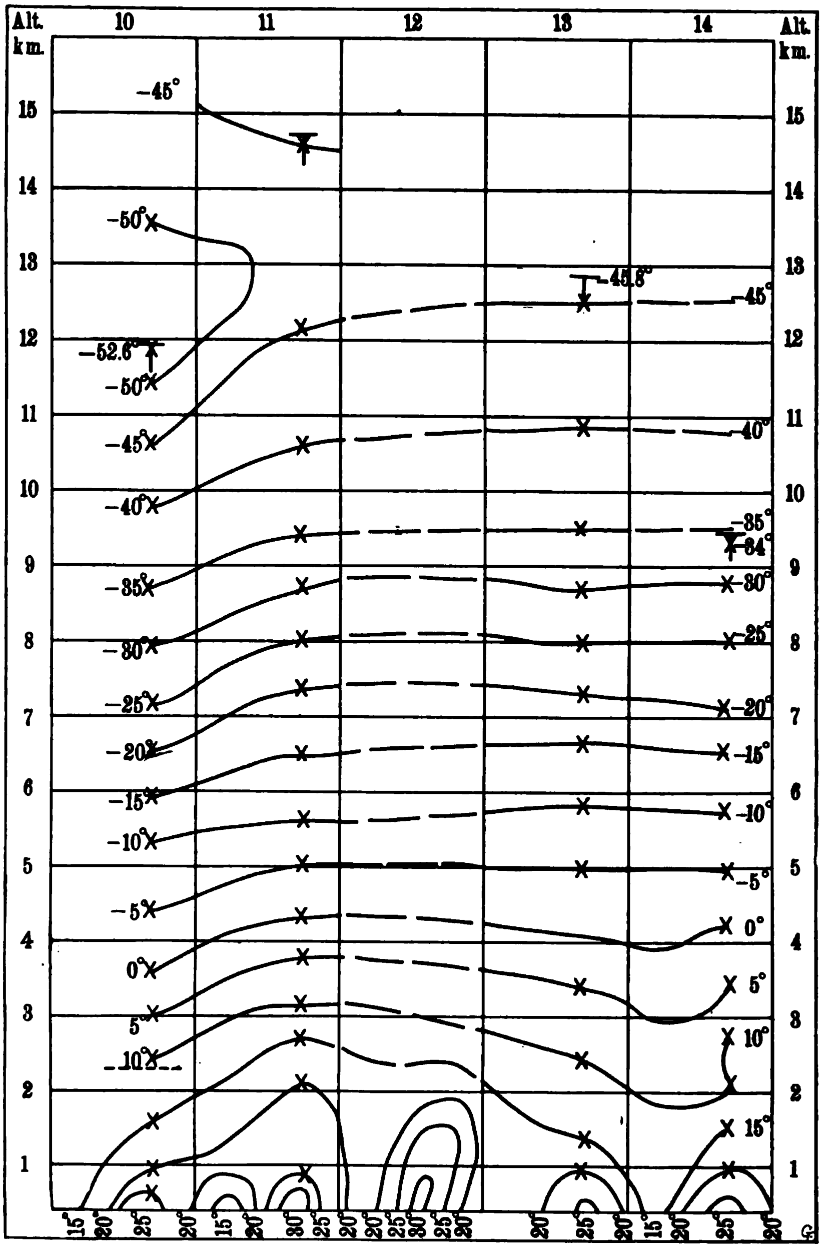

FIG. 13A.—Free air isotherms over Huron, Aug. 10-14, 1910.

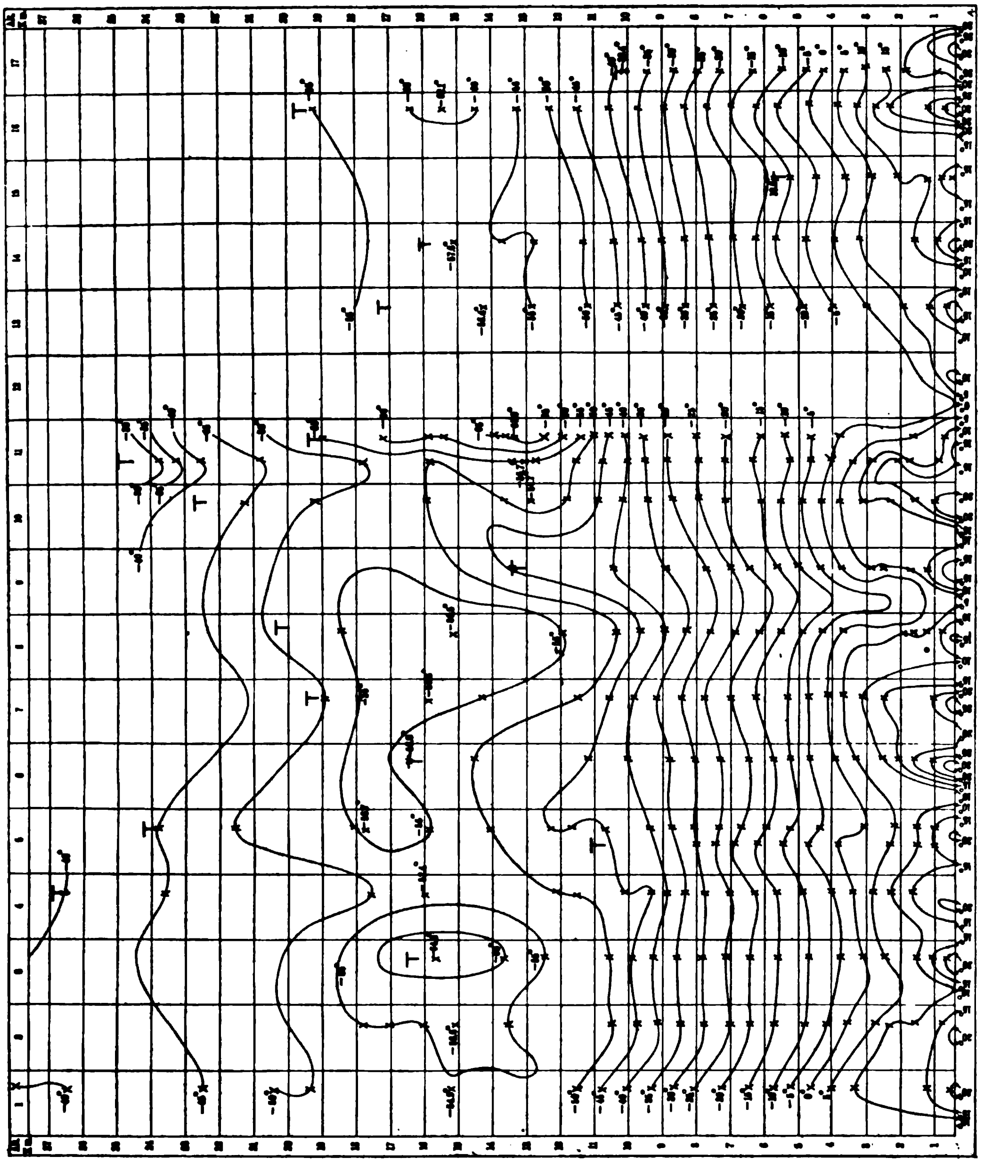

FIG. 13B.—Free air isotherms over Huron, Sept. 1-17, 1910.

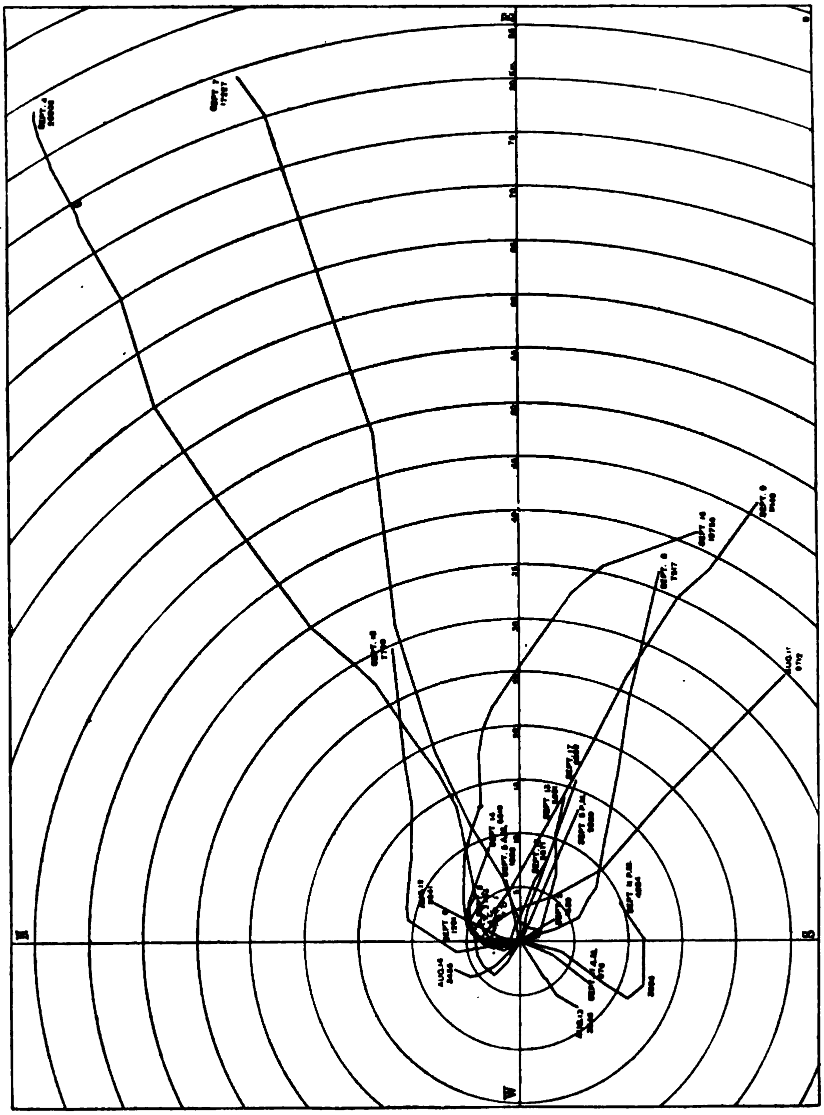

FIG. 14.—Horizontal projections of the paths of the balloons set free at Huron, Aug. 10–Sept. 17, 1910.

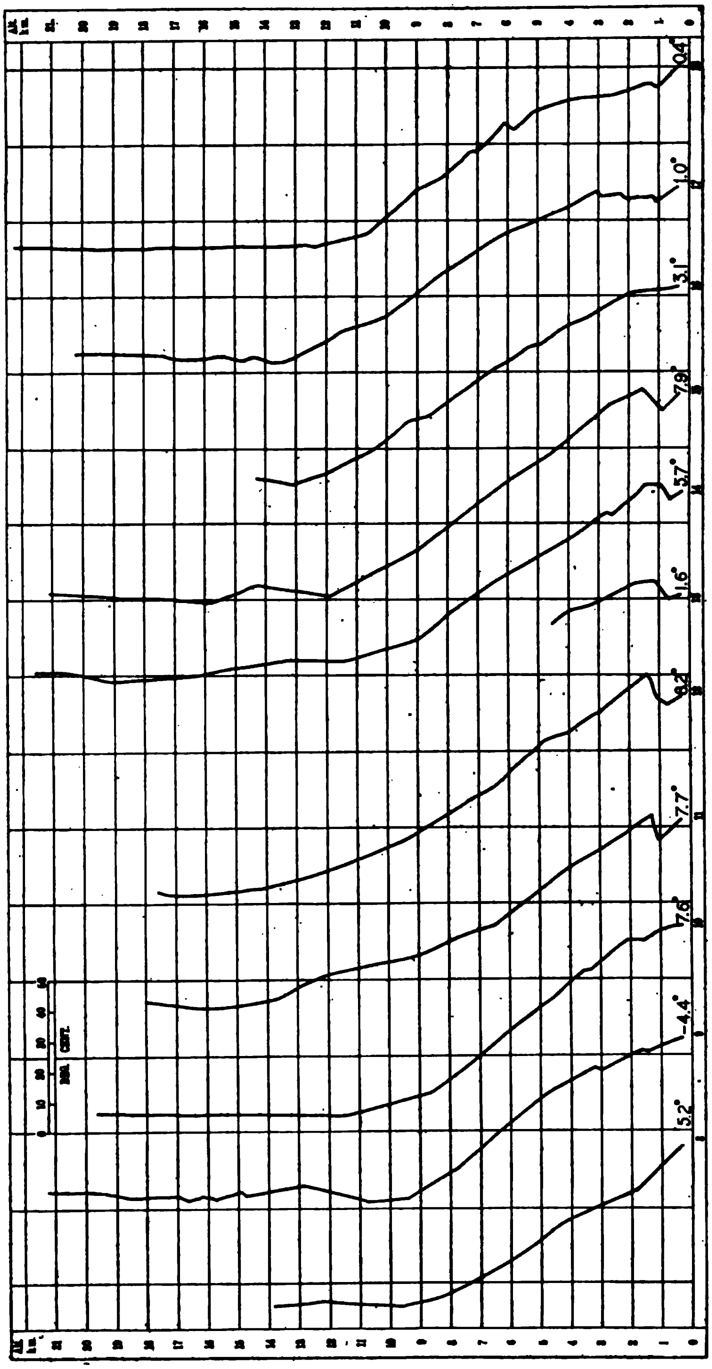

FIG. 15A.—Vertical temperature gradients as observed at Omaha, Feb. 8-18, 1911.

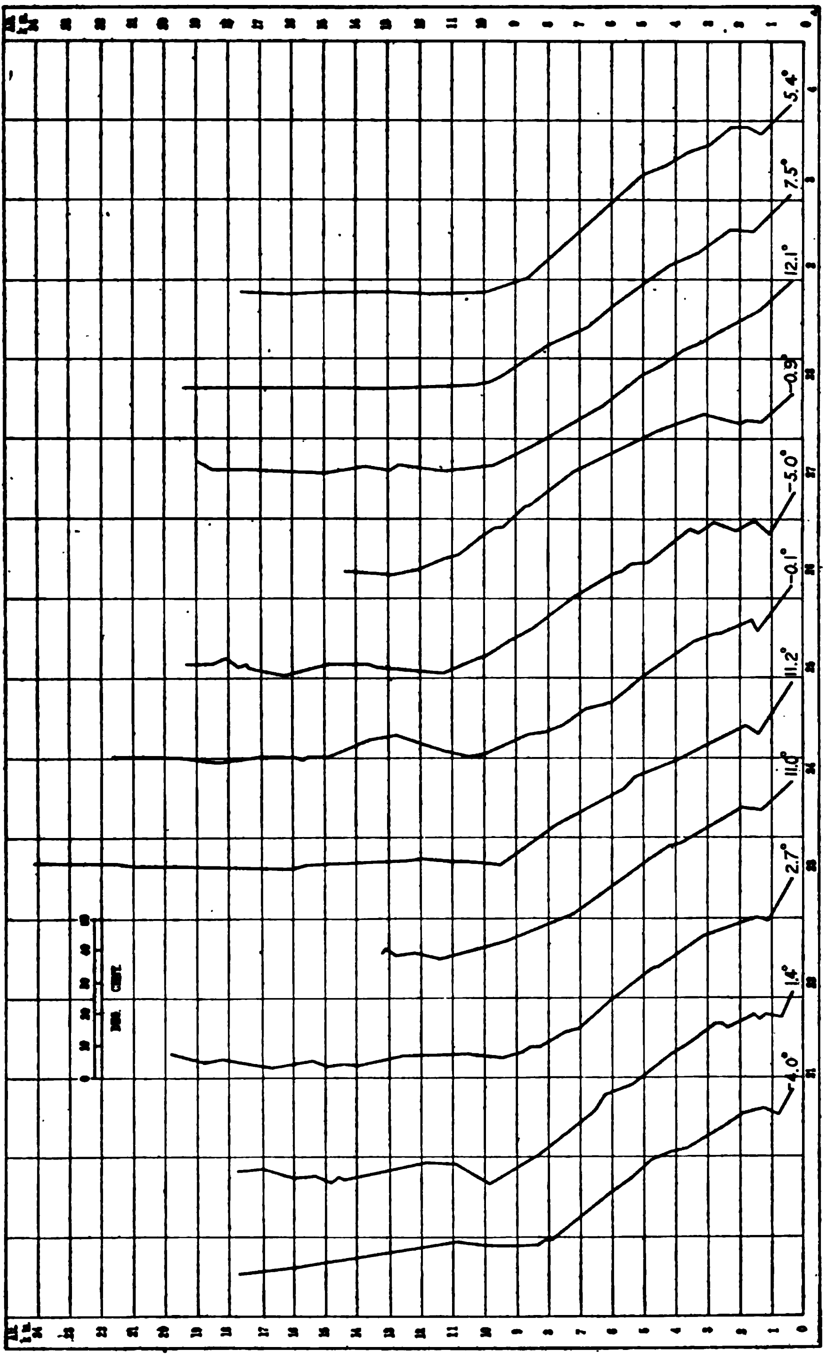

FIG. 153.—Vertical temperature gradients as observed at Omaha, Feb. 21-Mar. 4, 1911.

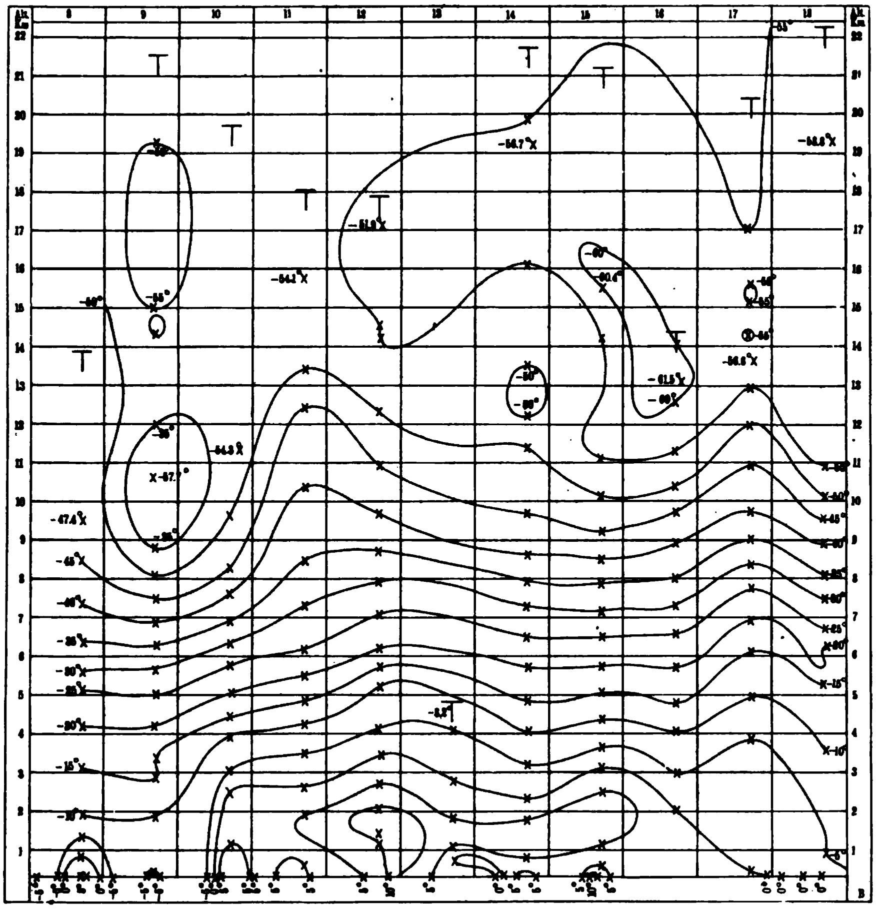

FIG. 16A.—Free air isotherms over Omaha, Feb. 8-18, 1911.

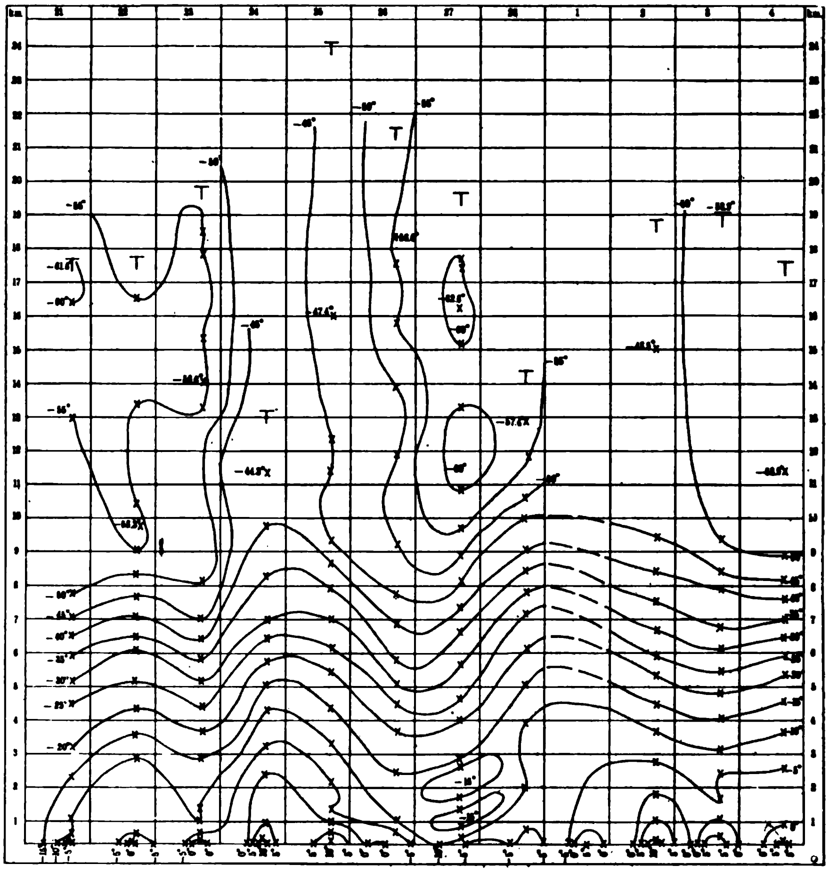

FIG. 16B.—Free air isotherms over Omaha, Feb. 21-Mar. 4, 1911.

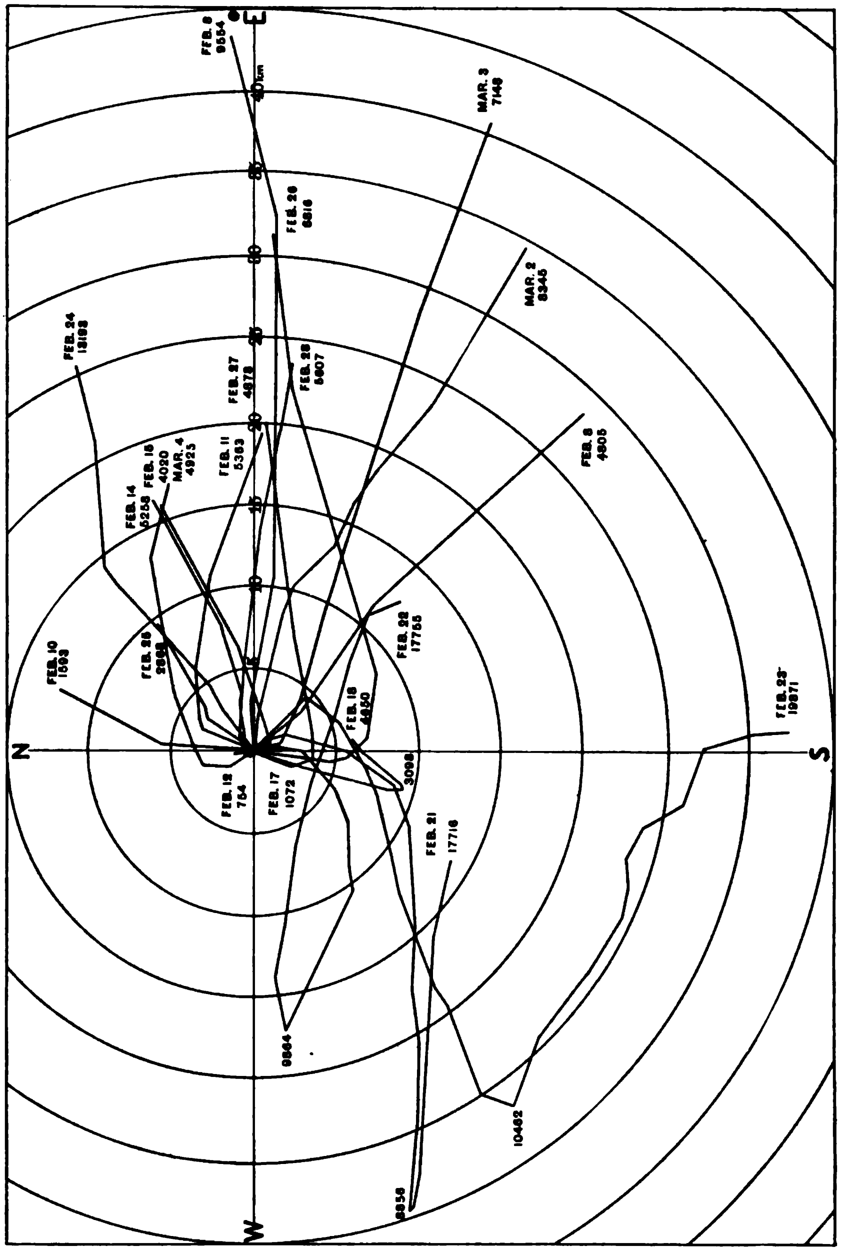

FIG. 17.—Horizontal projections of the paths of the balloons set free at Omaha, Feb. 8–Mar. 4, 1911.

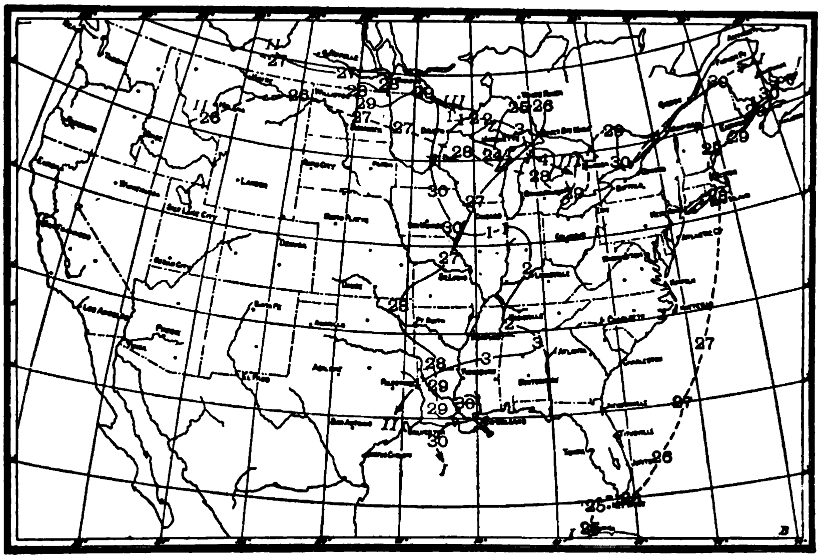

FIG. 18.—First series, Sept. 25-Oct. 3, 1909.

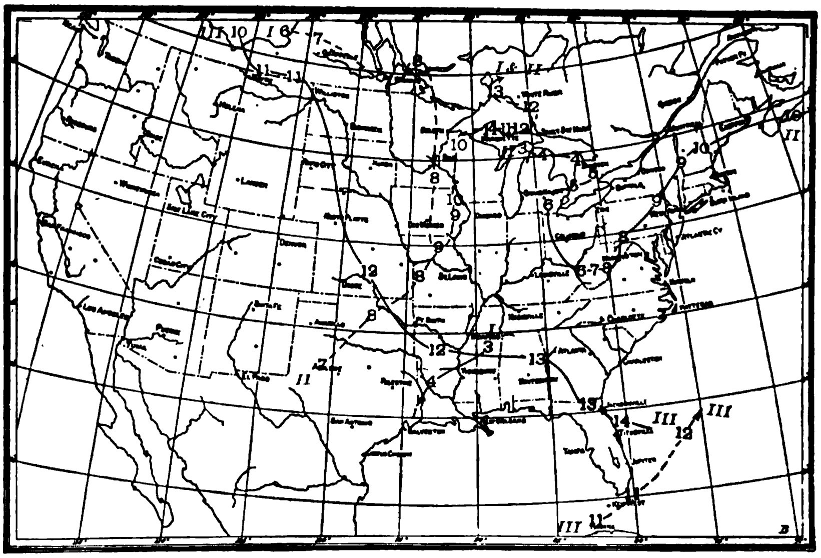

FIG. 19.—First series, Oct. 4-12, 1909.

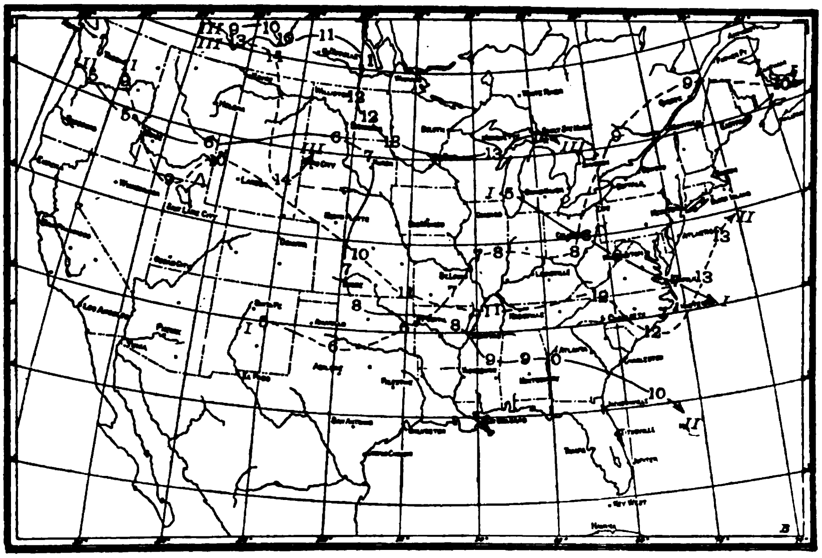

FIG. 20.—Second series, May 6-13, 1910.

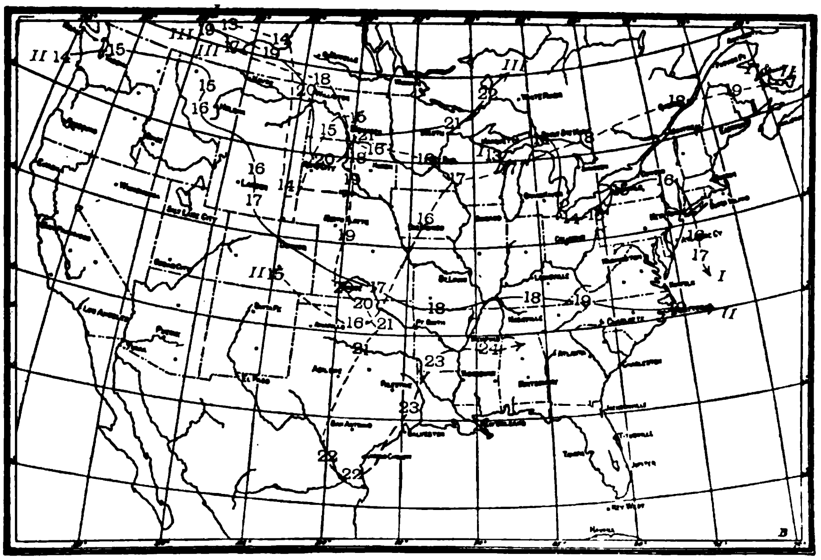

FIG. 21.—Second series, May 14-22, 1910.

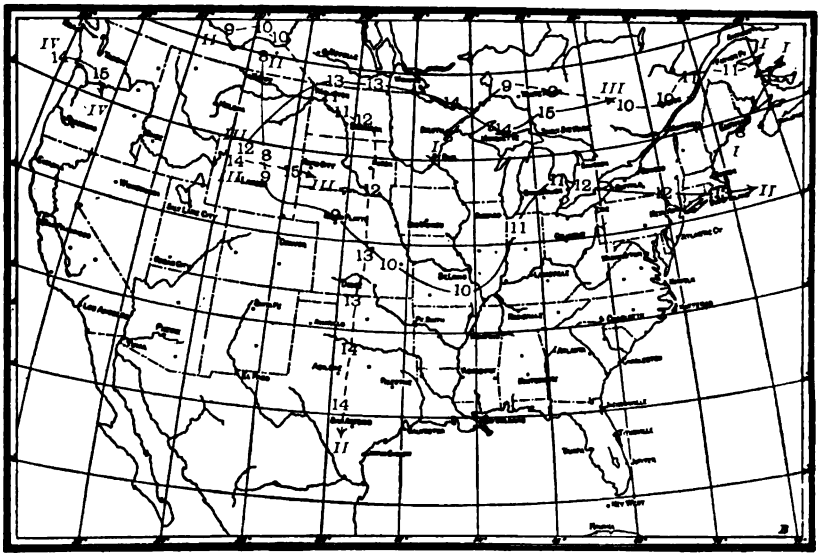

FIG. 22.—Third series, Aug. 9-14, 1910.

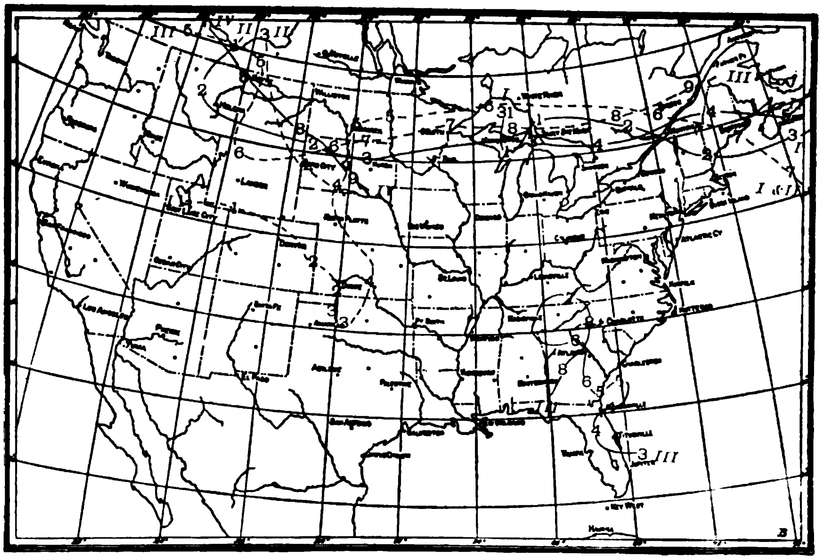

FIG. 23.—Third series, Sept. 1-8, 1910.

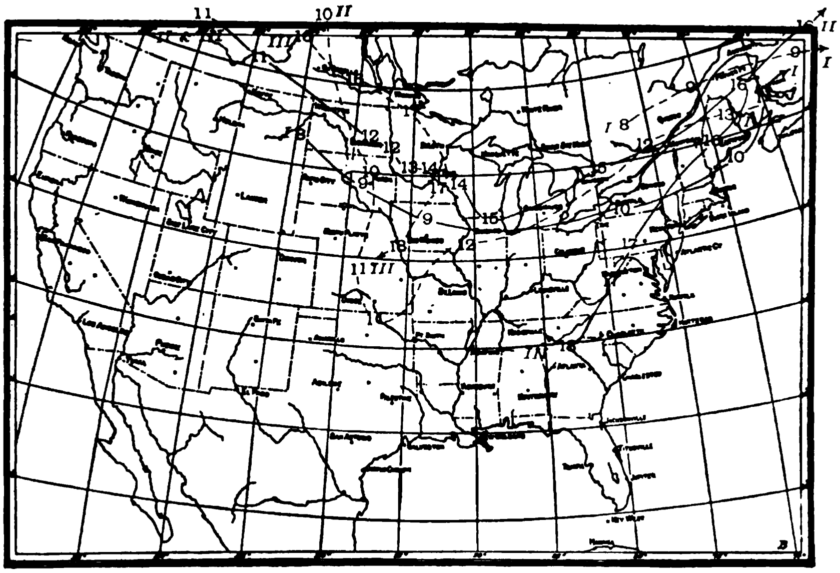

FIG. 24.—Third series, Sept. 9-17, 1910.

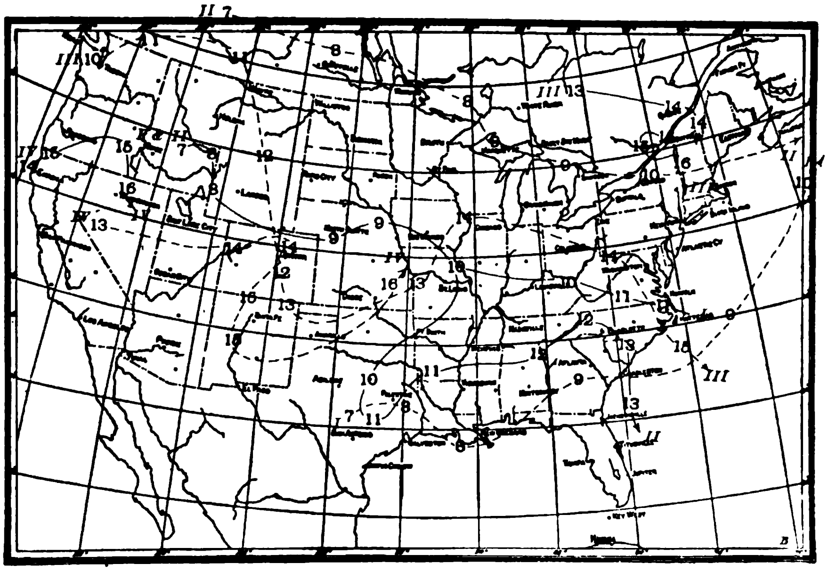

FIG. 25.—Fourth series, Feb. 8-15, 1911.

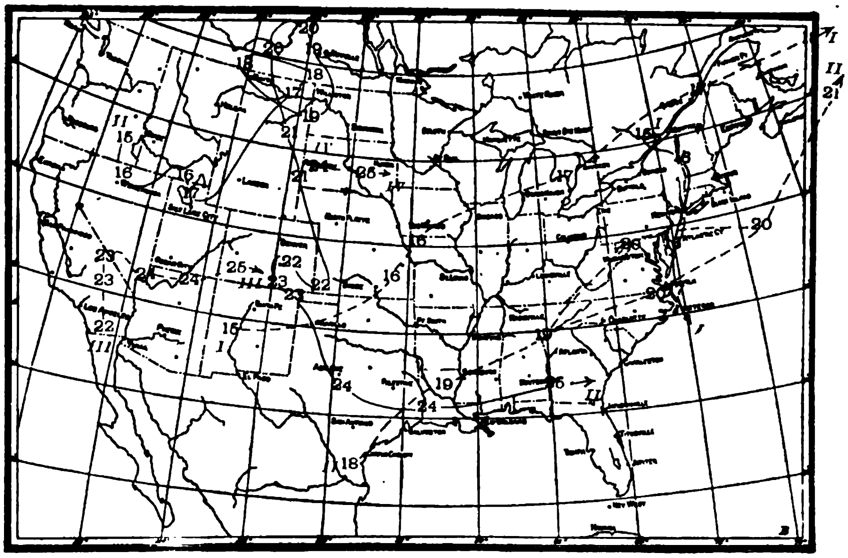

FIG. 26.—Fourth series, Feb. 16–24, 1911.

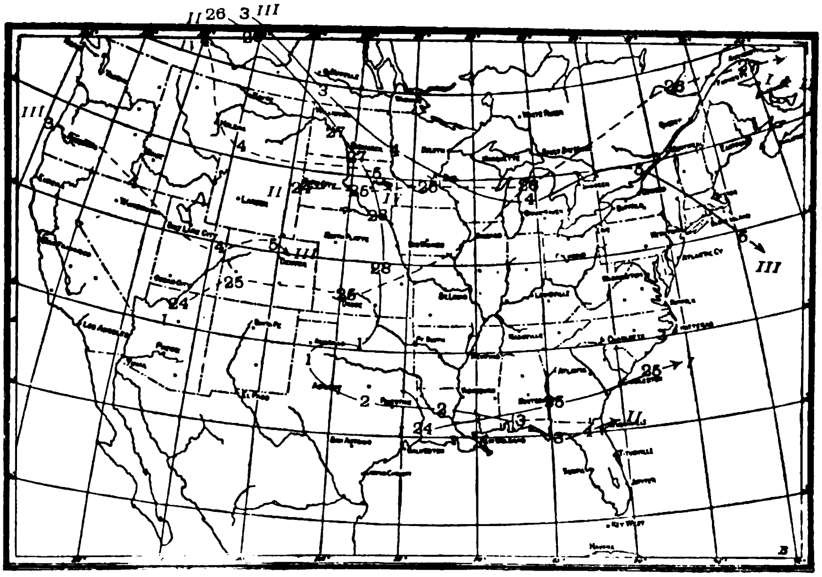

FIG. 27.- Fourth series, Feb. 25–Mar. 4, 1911.

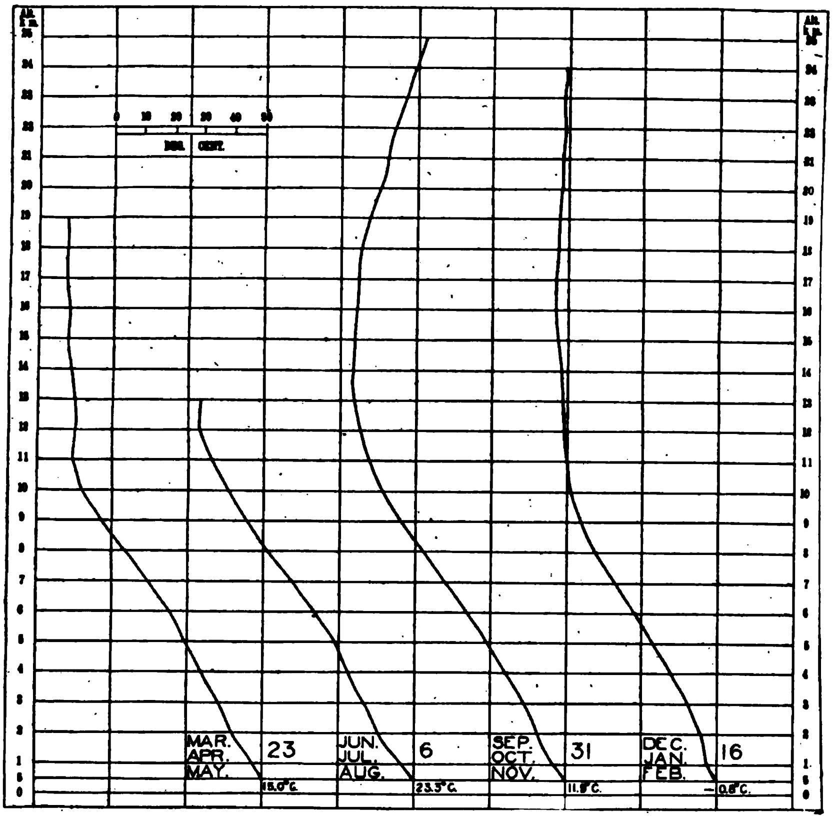

FIG. 28.—Mean vertical temperature gradients by seasons over rising air pressure at the earth's surface.

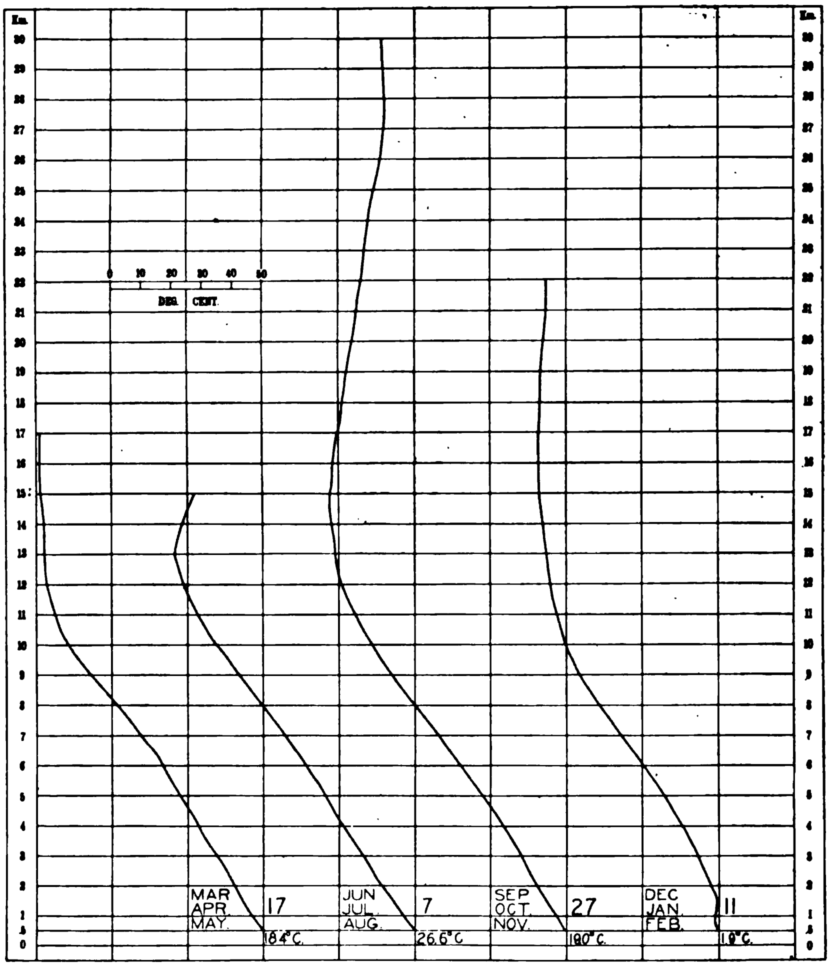

FIG. 29.—Mean vertical temperature gradients by seasons over falling air pressure at the earth's surface.

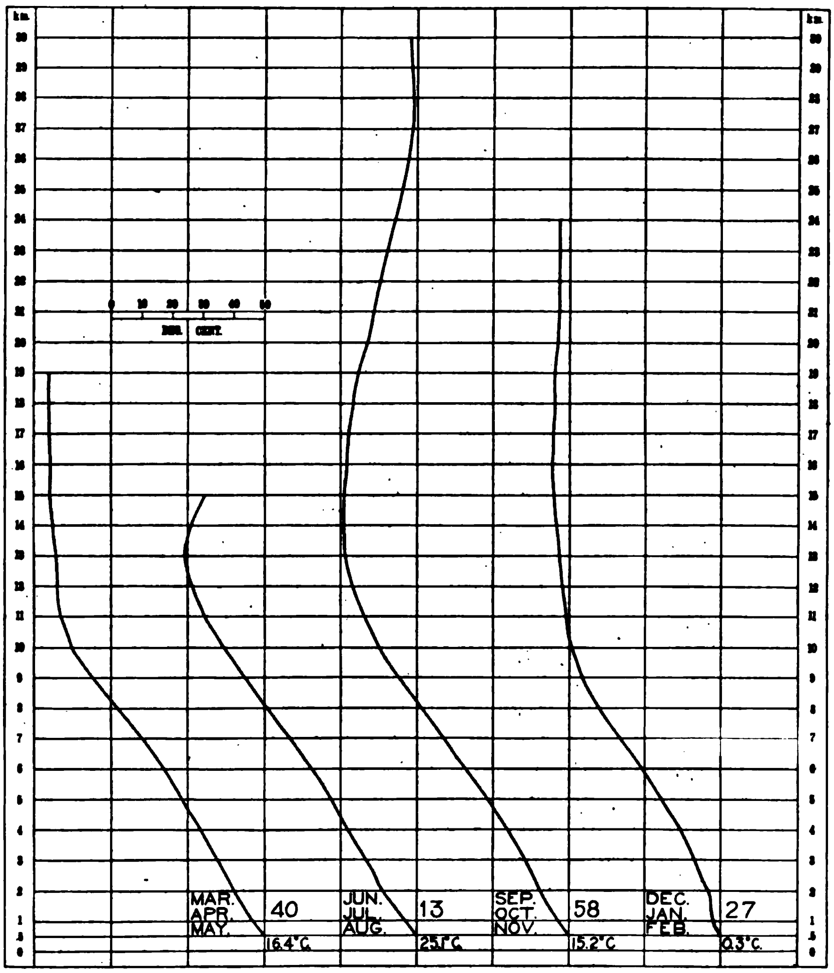

FIG. 30.—Mean vertical temperature gradients by seasons.

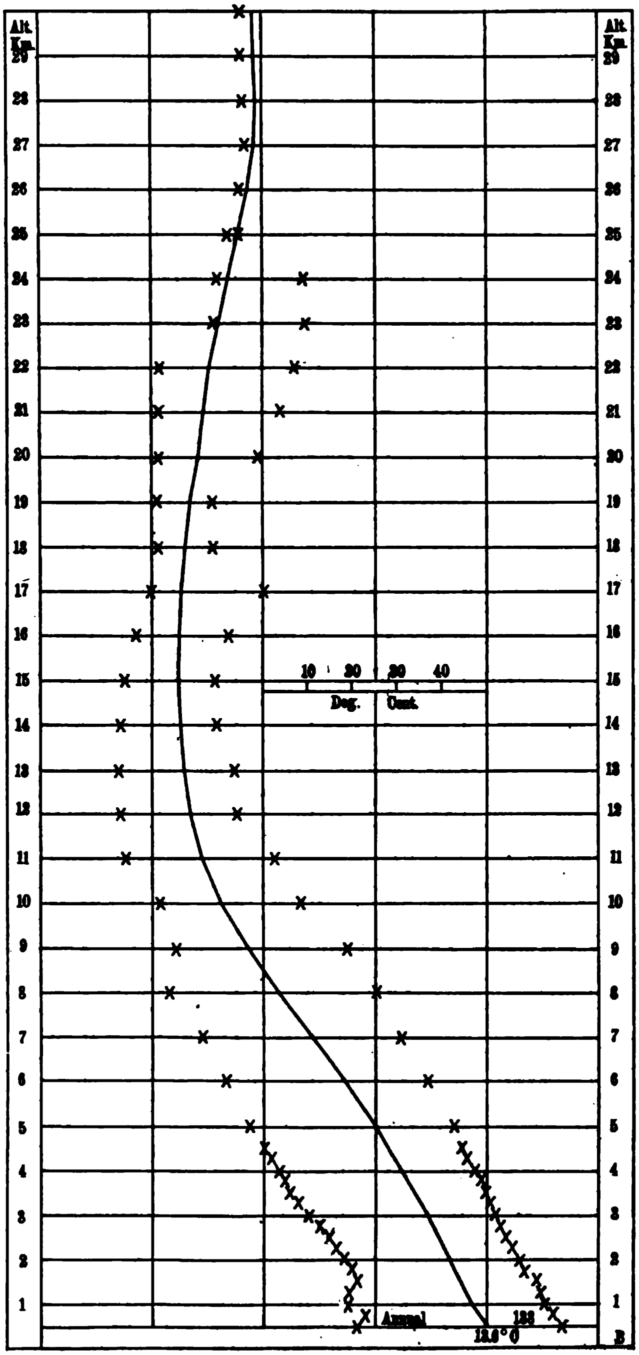

FIG. 31.—Mean vertical temperature gradient, based on all free balloon observations that have been made in the United States.

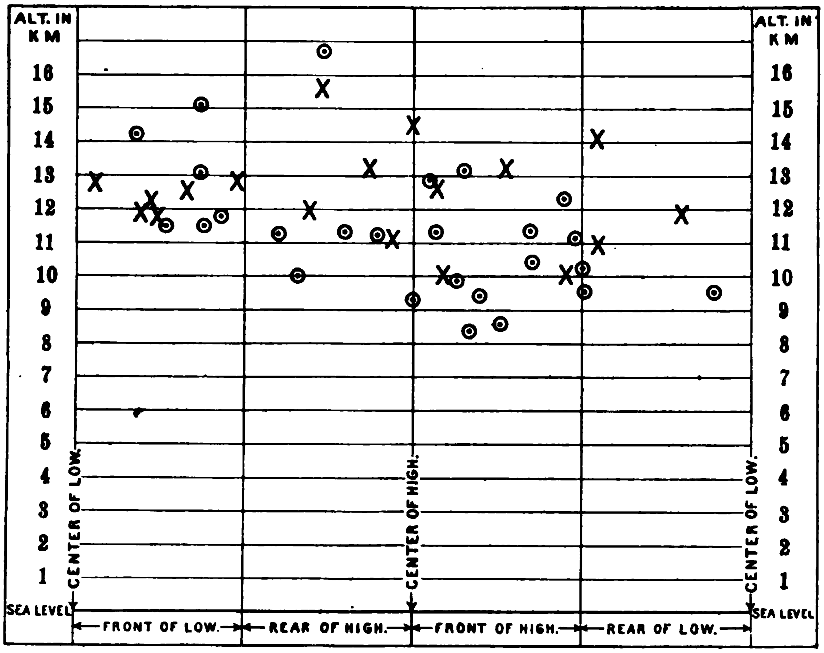

FIG. 32.—Variation in the altitude of the surface S with season and with air pressure at the earth's surface.

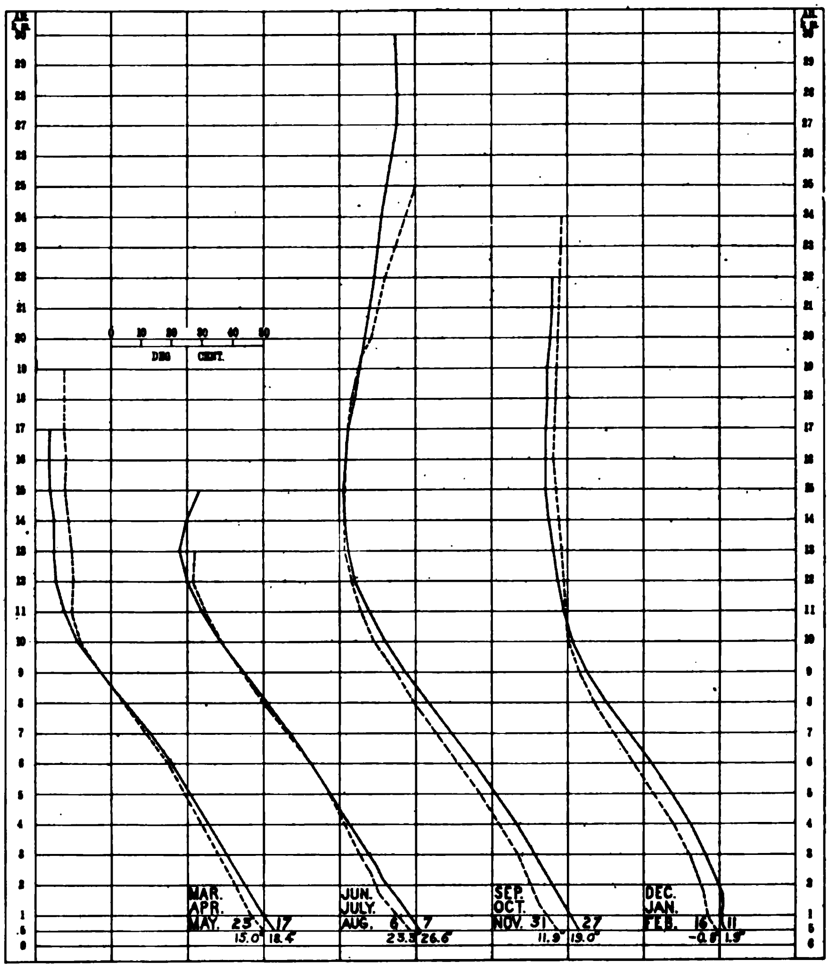

FIG. 33.—Comparison of the vertical temperature gradients over falling (solid lines) and over rising (dashed lines) air pressure at the earth's surface.

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U. S. DEPARTMENT OF AGRICULTURE.

[illegible] **BULLETIN** [illegible]

OF THE

MOUNT WEATHER OBSERVATORY

PREPARED UNDER THE DIRECTION OF
WILLIS L. MOORE, D. Sc., LL. D.
CHIEF U. S. WEATHER BUREAU

[illegible]

[illegible]
[illegible]

STAFF OF THE

MOUNT WEATHER OBSERVATORY.

Director	[illegible], Washington, D. C.
[illegible]	[illegible] Humphreys, Washington, D. C.
[illegible]	[illegible], Washington, D. C.

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	Herbert H. Kimball.
Assistant in Upper Air Research	[illegible]
Assistant in Upper Air Research	[illegible]
Assistant in Upper Air Research	[illegible]
Assistant in Upper Air Research	[illegible]
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BULLETIN

OF THE

MOUNT WEATHER OBSERVATORY

Vol. 4, Part 5. July, August, September, 1911. Closed Feb. 1, 1912.
W. B. No. 480. CLEVELAND ABBE, Editor. Issued Apr. 24, 1912.

(XVI) VERTICAL TEMPERATURE GRADIENTS IN HAWAII.

By ALFRED J. HENRY.

I am indebted to Mr. W. B. Stockman, section director of the Hawaiian section of the climatological service, for a record of the monthly mean temperatures at two pairs of stations in the island of Hawaii, whence it is possible to compute the vertical temperature gradient on the eastern or windward side of that island from approximately five years of observations.

The first pair of stations is Humuula, altitude 6,685 feet (2,037.6 meters), latitude 19° 43′ N., longitude 155° 26′ W., with Hilo as base station on the bay of the same name at 100 feet (30.5 meters). The geographic coordinates of the latter are 19° 44′ N., 155° 3′ W. The second pair of stations is Volcano House, latitude 19° 25′ N., longitude 155° 15′ W., altitude 4,000 feet (1,219.2 meters), and Kapoho, altitude 110 feet (33.5 meters), latitude 19° 31′ N., longitude 154° 48′ W.

Both base stations are practically at sea level. Humuula appears to be on the high table-land between Mauna Kea and Mauna Loa, almost due west of Hilo and about 25 miles (40 kilometers) distant therefrom. Volcano House is near the volcano of Kilauea and a little south of west from Kapoho the base station. The latter is situated on the most eastern point of land in Hawaii. The vertical temperature gradients in degrees centigrade per 100 meters for each month and season are given in the table below.

As might be expected from the constancy of the temperatures in the region of the northeast trades of the Pacific, which control the temperatures of the Hawaiian Group, the vertical gradients show very little variation during the year, being greatest in spring in both pairs of stations, but least in summer at the northern pair and least in autumn at the southern pair. The value of the gradient differs only slightly from that already found for mountain regions in the Tropics.

Vertical temperature gradients (degrees centigrade per 100 meters) in the island of Hawaii.

[Difference in altitude: Humuula–Hilo, 2,007 meters equal 6,585 feet; Volcano House–Kapoho, 1,186 meters equal 3,890 feet.]

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Humuula–Hilo	0.58	0.55	0.57	0.57	0.55	0.55	0.54	0.55	0.55	0.56	0.57	0.54	0.554
Volcano House–Kapoho	.58	.59	.63	.62	.60	.58	.60	.59	.57	.59	.50	.53	.58

SEASONAL.

	Winter.	Spring.	Summer.	Autumn.
Humuula–Hilo	0.557	0.563	0.547	0.560
Volcano House–Kapoho	.567	.617	.590	.553

(XVII) DIURNAL VARIATION OF PRESSURE AT POINT REYES LIGHT.

By JAMES JONES.

[Dated October, 1911.]

I submit herewith the data on the diurnal variations, etc., of pressure at Point Reyes Light.

In preparing these data the summer months and only those days that appeared to be free from accidental variations of pressure were used.

It will be seen that there appears to be a slightly greater range on windy days than on quiet days, though there are many exceptions.

It is, however, a well established fact that, at this place, as the northwest wind increases the pressure decreases, and when an increasing wind movement from the northwest coincides with the regular daily increase in pressure the range is increased thereby.

This decrease in pressure with increase in wind velocity is not found at near-by stations, and is believed to be a local effect, due to the topography. Point Reyes lies almost at right angles to the direction of the northwest wind, and rises almost perpendicularly from the ocean to a height of about 500 feet. It is clear, therefore, that a very strong vertical component must be a feature of the northwest winds, and this is thought to operate to produce a partial vacuum where the office is located. It is a fact worthy of notice that with a northwest wind of 50 miles an hour one can sit outside of the office building in comfort, though overhead the wind is roaring through the storm-warning tower at a terrific rate. At such times it is interesting to watch pieces of paper and other light articles that may be caught by the wind. They are swept across the ridge at tremendous speed, but immediately after crossing the summit they begin to flutter down in an almost calm atmosphere. Sometimes, after they have fallen far below the level of the station, a vagrant breeze, sweeping around the extreme end of the ridge, will lift them high again, but they never escape from the eddy, and all eventually fall near the base of the cliffs on the south side.

It has long been thought that interesting and possibly instructive data might be obtained by placing one extra barograph near the base of the cliffs on the south side of the ridge and another in a similar position on the north side, the records thus obtained to be studied in connection with the records of wind velocity and direction.

Diurnal range of atmospheric pressure on quiet days and windy days at Point Reyes Light, Cal.

Days with average wind velocities of not over 30 miles per hour.

Date.	Average velocity.	Amplitude of pressure oscillation.
1909.	*Miles.*	
May 2	9	0.10
3	10	.06
4	27	.06
5	24	.07
6	14	.05
7	20	.05
22	21	.05
June 5	29	.07
9	18	.07
19	18	.07
July 7	27	.05
22	24	.08
27	30	.06
29	16	.09
Aug. 2	11	.05
5	27	.06
7	22	.07
9	10	.05
12	29	.06
13	25	.07
15	30	.05
16	18	.07
17	10	.04
18	11	.05
24	22	.07
25	17	.08
26	25	.08
27	24	.06
1910.		
May 2	28	.04
3	23	.03
5	5	.06
6	13	.05
10	14	.08
15	24	.08
18	9	.03
19	8	.03
24	8	.04
26	12	.06
27	28	.07
28	29	.05
30	25	.04
31	12	.05
Aug. 3	14	.05
4	18	.05
8	11	.03
9	7	.04
Sums	856	267
Means	18.6	.058

Days with average wind velocities of over 30 miles per hour.

Date.	Average velocity.	Amplitude of pressure oscillation.
1909.	*Miles.*	
May 8	46	0.08
9	57	.07
10	54	.07
15	34	.06
16	32	.07
17	39	.07
18	40	.06
19	47	.10
20	57	.05
21	48	.05
23	32	.06
25	32	.05
27	41	.04
June 3	41	.06
13	54	.06
16	33	.05
20	32	.06
21	33	.07
23	31	.08
27	38	.06
July 2	42	.07
8	35	.07
10	47	.06
12	34	.08
13	33	.05
16	49	.06
17	52	.09
18	32	.05
19	32	.09
21	31	.06
23	34	.06
24	36	.05
26	58	.06
Aug. 22	39	.08
1910.		
May 1	41	.05
29	32	.09
June 13	69	.05
15	36	.06
22	49	.08
24	35	.06
25	33	.04
26	41	.04
July 2	34	.05
30	38	.05
31	38	.05
Aug. 1	36	.07
6	33	.06
Sums	1,880	295
Means	40.0	.063

APPENDIX, NOV. 11, 1911.

Steamships bound north during high northwest winds usually hug the shore line as closely as possible until after rounding the point. On one occasion particular attention was attracted to a steam schooner which, with her course laid apparently due northwest and a northwest wind of hurricane velocity blowing at the station, hoisted sail on her mainmast while in the lee of Point Reyes and with the wind shifting between southeast and west (judging by the position of the sail), rapidly overhauled a similar vessel that used no sail. After rounding Point Reyes the sail, of course, was lowered.

With Herschel's "barometric fogs" I am not familiar, but a phenomenon that might be so described has been observed here. During high winds fog sometimes forms on the lee side of the ridge but not on the windward side. By frequent comparisons with Mount Tamalpais it has been determined that a local wind of 60 miles per hour at Point Reyes depresses the barometer about 0.05 inch. It has been calculated that with the air at the normal Point Reyes temperature, reducing the pressure 0.05 inch will mechanically cool the air 0.242+° F. As it is not unusual for the depression of the dew point to be less than 0.242° at Point Reyes during high winds, it seems quite probable that the fogs to leeward are produced in the manner described, particularly when we consider that the depression of the barometer is probably even greater to leeward of the ridge than on the summit, where the office is located.

(XVIII) THE TEMPERATURE AT MOUNT WEATHER AND ADJACENT VALLEY STATIONS.

By ALFRED J. HENRY.

[Dated Oct. 31, 1911.]

In previous papers the writer has discussed the fluctuations of temperature at base and summit stations in the Rocky Mountain region.[1] In this paper it is proposed to discuss the temperature as recorded simultaneously at Mount Weather on the summit of the Blue Ridge, 526 meters (1,725 feet) above sea level, and at the valley stations near Berryville, Va., on the west, altitude 152 meters (499 feet), and near Middleburg, Va., on the east, altitude 137 meters (450 feet); also at Trapp, Va., directly at the foot of the mountain on the east side, altitude 217 meters (712 feet). The Blue Ridge Mountains, it may be remembered, form a part of the Appalachian system, which latter extends from Pennsylvania southwest to Georgia and Alabama.

That particular portion of the Blue Ridge upon which Mount Weather is located lies 6 miles south of Bluemont, Va., the terminus of the Bluemont branch of the Southern Railway. The Blue Ridge in that part of the State separates the Shenandoah Valley from what is known as Piedmont, Va., a gently rolling country immediately east of the mountains. To the west of the ridge opposite Mount Weather the Shenandoah River, whence the valley takes its name, closely hugs the mountains on its right bank. The station at Mount Weather is distant from the river about 5 kilometers (3½ miles). The intervening country is wooded and quite hilly. The prevailing winds at Mount Weather are westerly. The difference in level between the valley floor and Mount Weather is about 374 meters (1,227 feet); the horizontal distance is about 5 kilometers (3½ miles). The eastern slope of the Blue Ridge at Mount Weather is more abrupt, the descent from the summit to the floor of the valley on the east being accomplished in 1¼ miles, where the altitude, as at the village of Trapp, is but 217 meters (712 feet). The ascent of easterly winds to the summit of the ridge is therefore but a little over 300 meters (about 1,000 feet). Both valleys are in a high state of cultivation. The mountain sides in the neighborhood of Mount Weather are still wooded, although the top is partially cleared.

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[1] Bulletin of the Mount Weather Observatory, III, pp. 201-225; IV, pp. 103-116.

The Shenandoah Valley substation is situated on the farm of Mr. A. Cummins, on the outskirts of the town of Berryville, Va., about 6 kilometers (4 miles) from the river and 11 kilometers (7½ miles) from Mount Weather. It is locally known as Audley and will be referred to under that name in this paper. Its bearing from Mount Weather is N. 30° W. The substation on the eastern side of Mount Weather is situated on the farm of Mr. W. C. Benton, 13 kilometers (8 miles) from Mount Weather and bearing S. 57° E. therefrom. Mr. Benton's farm is about 2 miles from Middleburg, Va. The thermometer shelter at both stations is of the standard size used by the Weather Bureau and the exposure is over sod and free from disturbing influences of any sort.

Mount Weather is higher than the three base stations by the following amounts:

	Meters. Feet.
Above Trapp	309=1,013
Above Benton's, near Middleburg	389=1,275
Above Audley, near Berryville	374=1,226

The monthly mean temperatures at Mount Weather, Trapp, Benton's, and Audley are given in Table I. The means are from the hourly corrected readings of Richard thermographs. In all cases the general means have been corrected and reduced to a 33-year mean by the use of the charts in Weather Bureau Bulletin U, "Temperature departures, etc." It was necessary, however, to use the statistical data for Baltimore, Washington, Lynchburg, and Elkins in determining the corrections for individual months, because departures in the above-named bulletin are drawn for intervals of 2° F. only, and there is often an uncertainty of about that amount in the values for individual months, unless reference is had to the actual departures at surrounding stations.

The monthly mean temperature of Mount Weather is of course less than at base stations on the average of the year; the average decrease of temperature between mountain and low level stations the world over is not far from half a degree centigrade for 100 meters of altitude or about 1° F. for 364.5 feet of altitude. This rate would amount to about 2°.8 F. between Trapp and Mount Weather; 3°.5 between Benton's and Mount Weather; and 3°.4 between Audley and Mount Weather. An inspection of Table I shows that the differences between the monthly mean temperatures of Trapp and Mount Weather are larger than was to be expected, and that between Mount Weather and the valley stations on both sides the differences are slightly smaller than was to have been expected. The mean annual vertical temperature gradient expressed in centigrade degrees per 100 meters between Mount Weather and Trapp (base of mountain), three years observations is, 0.72; Mount Weather and Benton's (eastern valley), 0.46; Mount Weather and Audley (western valley), 0.39.

The period of observation at Benton's is but two and one-half years; at Audley barely three years. The eastern valley is slightly warmer than the western and the vertical temperature gradient is greatest, not between Mount Weather and the true valley stations, but between Mount Weather and Trapp at the base of the mountain on its east or south front. The stronger gradient between Mount Weather and Trapp is ascribed to the influence of topography and exposure. The general trend of the ridge at Mount Weather is northeast to southwest, so that its exposure is both to the east and south. It has been pointed out by Hann that the decrease of temperature is more rapid on the southern than the northern side of mountains and this seems to be true of the Blue Ridge at Mount Weather. Another cause of the low vertical temperature gradient between Mount Weather and valley stations is the frequent occurrence of negative gradients due to the settling of cold air in the valley floor. Air that is chilled on the mountain sides evidently flows past Trapp into the lower portions of the valley.

The seasonal vertical temperature gradients are shown in the small table below, expressed in centigrade degrees per 100 meters:

[From the corrected monthly means of Table I.]

	Winter.	Spring.	Summer.	Autumn.
Trapp	0.77	0.76	0.71	0.70
Bentons	.59	.44	.56	.29
Audley	.45	.40	.46	.27

There is not much difference in the rate of vertical decrease of temperature with increase of altitude between Mount Weather and Trapp for the several seasons. The valley stations, however, show a much reduced rate for all seasons and a marked minimum in autumn. Trapp is not a true valley station, but rather a station on the southern slope near but not on the valley floor. In a discussion of temperature observations at summit and base stations in the Rocky Mountain regions [1] the writer was led to the conclusion that the temperature distribution between two stations at different altitudes is conditioned by circumstances other than local topography and difference in elevation. This conclusion is supported by the observations at Mount Weather and valley stations. The small gradient in autumn can be definitely referred to the prevalence of anticyclonic weather in October and other months, whereby, instead of a diminution of temperature with altitude the mountain temperatures during the night hours are higher than the valley temperatures. The cooling in the valley is doubtless not wholly due to nocturnal radiation, since the latter is also effective on the mountain top, but partly to the settling of cooler air in the valley bottoms. An excellent example of the temperature distribution during the prevalence of anticyclonic conditions in which there is little if any movement of the anticyclone is afforded by the record of October 5 to 10, inclusive, 1909—a six-day period during which an anticyclone was central over Mount Weather. The mean temperatures for each of the 24 hours of the six-day period have been computed and their differences above or below the corresponding values for Mount Weather are given in Table II. Minus signs indicate that the temperatures at Mount Weather were lower than at valley stations, and an absence of signs the contrary.

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[1] This bulletin, vol. 4, pt. 3., p. 103.

It will readily be seen that the greatest lowering of the temperature below that of the mountain top was in the eastern valley, where topographic conditions are most favorable for the local accumulation of cooled air in the neighborhood of the station at Benton's farm. The land of the latter is more or less rolling, and Goose Creek, a considerable stream, passes through the farm within a quarter of a mile of the thermometer shelter. The land on which the station in the western valley is situated is nearly level and more closely approaches a plane surface than does the land at Benton's. There is therefore apparently less opportunity for settling of cold air into the western than into the eastern valley. The effect of insolation is not operative in the western valley so soon as in the eastern, as shown by the fact that the temperature in the latter is higher than on the mountain at 10 a. m. on the average, while the temperature of the western valley does not rise above that of the mountain on the average of the period in question until 11 a. m. This statement holds for all seasons.

The lowering of the temperature at Trapp on the foot of the mountain directly east of Mount Weather during the anticyclonic conditions above mentioned was not nearly so great as at Benton's, probably due to the fact that the air which cools on the mountain top and sides must flow down and past Trapp toward the lower portions of the valley, which are as much as 80 meters (262 feet) below Trapp. The hourly temperatures for the last-named place, as may be seen from Table II, are higher than those on the mountain top except for the hours of 4 to 7 in the morning, when the Trapp temperatures are slightly lower than those of Mount Weather.

The temperature on Mount Weather and at adjacent valley stations begins to fall in October about an hour before sunset; during the hour immediately before sunset it falls most rapidly at Trapp and Benton's, which at that time of day are mostly in the shadow of the mountain. During the hour immediately after sunset (6 to 7 p. m.) the temperature of the two valley stations falls very rapidly and continues to fall up to the time of the occurrence of the diurnal minimum, viz, for the eastern valley, at 6 a. m.; for the western, at 7 a. m. The foregoing named hours and this discussion relate to the conditions during six days of anticyclonic weather in October, 1909.

It will now be interesting to compare the foregoing results, which apply to anticyclonic conditions in autumn, with the weather conditions during the prevalence of anticyclones in winter. For this purpose a selection was made of all the days in the two winters of 1909–10 and 1910–11, respectively, when an anticyclone was central over or near Mount Weather. In all 21 such cases were found. The average sea-level pressure at 8 a. m., seventy-fifth meridian time, at Mount Weather for the 21 days was 30.45 inches (773.43 mm.). The average temperatures were as follows:

	Fahrenheit.	Centigrade.
	Degrees.	*Degrees.*
Mount Weather	25.7	−3.5
Trapp	30.3	−0.94
Bentons	25.6	−3.61
Audley	25.0	−3.89

The individual records show that in 11, or 52 per cent, of the cases of winter anticyclones the daily mean temperature of Mount Weather was slightly above that of the valley stations; in the remaining cases, 48 per cent of the whole number, the daily mean temperature of Mount Weather was lower than that of valley stations; hence, so far as the records at Mount Weather are concerned, it can not be assumed that in general the lowlands in winter are colder than the mountain slopes and summits adjacent thereto, as is said to be the case generally elsewhere. The determining factor as to whether an inversion of temperature will occur between the mountain top and the valley floors on both sides is clearly the lack of movement of the atmosphere, whereby the drainage of cold air to the lower levels in the valley floor is facilitated. The average wind movement for the six days in October, 1909, heretofore described, was between 5 and 7 miles per hour (2.24 to 3.13 meters per second), while the average movement for the month was 14 miles per hour (6.27 meters per second). The vertical temperature gradient between the mountain top and valley stations during the prevalence of high winds approaches rather closely the adiabatic rate for dry air, as will again be referred to in this paper. Inverted gradients between the valley and the mountain top are also caused in a manner entirely different from that above described, which indeed has ordinarily been known as the "cold air drainage" process, by which the valley stations become colder than the mountain top. The second process involves the warming of the mountain top, probably by horizontal currents which envelop it before they descend to the lowlands. These horizontal currents are due to a type of pressure distribution illustrated in the daily weather maps of the United States for January 20 and February 7, 8, 1910, reproduced in this paper as figures 4, 6, and 7. The distinctive feature of these maps, and the one to which attention is directed, is the relative position of the dominating anticyclone and the cyclone with reference to Mount Weather. The latter is invariably on the western side of the anticyclone in the region of southerly or southwesterly winds which are intensified by the position of the cyclone to the northwest or north. The latter, as in the case of February 7, may be only partially developed and of little energy, using the word energy as indicating the presence or absence of strong winds and stormy weather about the center of the cyclone. Yet the barometric gradient is sufficient to produce southwesterly winds. The change in the winds at Mount Weather from northwest to southwest occurred between 4 and 5 p. m. on the 7th. Surface winds from the southwest are warm winds at Mount Weather.[1]

The two processes above described are effective in producing an inverted gradient between the mountain and valley stations; they depend on special weather conditions and not on topography alone.

In January and February, 1910, and January, 1911, a total of 90 days, the daily mean temperature on Mount Weather was higher than that of the valley stations, Benton's and Audley, on 25 days, or 28 per cent of the time. The vertical temperature gradient between Mount Weather and the valley stations for these 25 days was an inverted one as follows: Benton's – 0.71 C. per 100 meters; Audley, – 0.83 C. per 100 meters. The vertical temperature gradient between Trapp and Mount Weather for the same 25 days was but – 0.29 C. per 100 meters. The low value for Trapp is due to the fact that on 9 of the 25 days the gradients between that station and Mount Weather were positive instead of negative.

The mountain effect.—It is apparent from the preceding that the mountain effect on the temperature of the air on its surface is not merely that due to altitude, but differs for different weather conditions. The average difference between the temperatures on Mount Weather and in both valleys can easily be determined, but for individual dates corrections so determined would give unsatisfactory results. We have taken the mean hourly temperatures for mountain and valley stations for such time as available[2] and computed the departures by seasons for all sorts of weather conditions. These results expressed as departures from the mean of the 24 hours are given in Table III. The values with minus signs prefixed indicate that the correction to reduce to the true daily mean is additive; those without sign that it is subtractive. From these results we have computed a table of corrections for reducing the temperatures observed on Mount Weather to the true daily mean and also to the level of the valley below. The valley correction was obtained as follows: In winter the mean difference between Mount Weather and the eastern valley was found to be – 1.7° F.—that is, the temperature at Mount Weather on the average of all conditions was 1.7° F. lower than the eastern valley temperatures for the same season. Likewise the mean difference of the western valley was found to be – 3.2° F. Combining these two mean differences we have as a general mean – 2.4° F. (– 1.33° C.), and this difference was used as a constant for all hours of the day in winter; thus from Table III for 8 a. m. in winter we obtain + 2.2° F. as the correction to reduce readings made at that hour to the daily mean. Combining these two corrections into one, and remembering that both are additive, we have + 2.2° F. + + 2.4° F. = + 4.6° F., which being changed to the centigrade scale = 2.56° C., as given in Table IV. The records, especially at the valley stations, are not long enough to give accurate averages, and since the average vertical temperature gradient between the mountain top and the valley varies for the different seasons of the year and even for the same month in different years there is probably some uncertainty as regards the correction for altitude used. The constant corrections used for altitude were:

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[1] This bulletin, Vol. I, p. 148.

[2] See last column of Table III.

	Gradient per 100 meters.
Winter, +2.4 F. (1.33 C.)	0.35
Spring, +2.8 F. (1.56 C.)	0.41
Summer, +3.4 F. (1.89 C.)	0.50
Autumn, +2.4 F. (1.33 C.)	0.35

The above gradients differ somewhat from those previously given for the separate valleys. Those previously given were deduced from the corrected monthly means given in Table I, while the above values have not been corrected for secular variation and hence the difference.

Temperature gradients in clear and cloudy weather.—In the neighborhood of the earth's surface the presence or absence of cloud or fog greatly alters the ability of the atmosphere to absorb and emit solar heat, hence it is important to consider the vertical temperature gradients for clear and cloudy weather separately. To this end the vertical temperature gradients between the mountain and valley stations have been computed separately for clear and for cloudy weather for the four seasons and the results appear in Tables V and VI. The degree of cloudiness was in all cases determined from the records kept on the mountain top where an automatic sunshine recorder of the Marvin type is in operation. A day was considered as clear when the recorded cloudiness was not in excess of three-tenths on a scale of 0 to 10 and cloudy when the cloudiness was eight-tenths or over. The vertical temperature gradient in degrees centigrade per 100 meters between Mount Weather and valley stations, for clear and for cloudy weather, respectively, is exhibited in Tables V and VI, as above stated. It will be noticed from these tables that in general the gradient is greater in cloudy than in clear weather, especially in summer and autumn; the annual rate of temperature decrease in clear weather being 0.39° C. per 100 meters, and 0.55° C. per 100 meters in cloudy weather. If the night hours be eliminated it will be found that the vertical temperature gradient between mountain and valley stations for the daylight hours is considerably greater in clear weather than in cloudy weather. The contrasts in temperature are greater in sunshine than in cloudiness and consequently the gradient is greater. Another important feature which can be read from the tables is that no inversions of temperature between the mountain top and the valley below seem to occur in cloudy weather. In clear weather, however, the temperature in the valleys, on the average for practically all night hours between 10 p. m. and 6 a. m. is lower than for the same hours on the mountain top for all seasons of the year. The lowering of the temperature in the valley is greatest in spring and summer.

Vertical gradient as depending on wind movement.—The vertical temperature gradient between Mount Weather and valley stations is to some extent conditioned upon the wind movement. As previously stated absence of wind movement facilitates the flow of chilled air down the mountain sides into the valleys below and thus causes a reversal of the ordinary gradient. High winds on the other hand keep the air in motion and the conditions closely approach those of ascending currents with a correspondingly increased gradient. A definite relation between wind velocity and vertical temperature gradient can not be distinguished from the observations at this place, possibly, however the difficulty lies in separating the wind effect from other influences that may be operative at the same time. There is more or less uncertainty as to whether the air which passes across the mountain at this observatory during high winds previously formed the surface layer over the valley floor or whether it was in thermal equilibrium at a higher level in the atmosphere. It was the experience of one of the observers at this station who lived for a time at the foot of the mountain on the eastern side that the strong southeast wind that prevails at times on the mountain top is not felt at the foot of the mountain. This observation would seem to indicate that the surface air of the valley close to the mountain is not involved in the currents which pass across the mountain. For if it were, there would doubtless be some indication of chilling by expansion as it reached the top. It would seem that the vertical temperature gradient between Mount Weather and the windward side of the mountain should closely approach the adiabatic rate for dry air in the case of no cloudiness. Air which passes across the mountain in high winds evidently does not closely follow the contours of the land but tends to curl back on itself in the layers next to the surface. The kites have shown on several occasions a motion of the air as indicated above. At Trapp, which is distant from the the mountain top but a mile and a quarter, the wind blows fiercely when a gale is blowing on the mountain top. It is impossible to say to what extent there is an actual descent of air in the case of strong wind on the mountain top. When the high winds begin there is probably considerable mixing of imported air currents with the layer of quiescent air *in situ* immediately over the foothills of the mountain on the leeward side, but as the storm continues it is believed that fresh air is continually descending upon the valley. Some statistics on the question follow.

On January 9, 1911, the average velocity of the wind at Mount Weather was 50.8 miles per hour from the west-northwest; the daily mean temperatures and vertical temperature gradients for both valleys are given below.

	Daily mean.	Vertical gradient.
	°C.	*°C. per 100 meters*
Mount Weather	−2.06	....
Windward valley	0.56	0.64
Leeward valley	1.44	0.90
Trapp, at foot of leeward side	1.00	1.00

In winter 38 days with west and northwest winds averaging 34.7 miles per hour (15.5 meters per second) give vertical temperature gradients as follows:

Windward valley	0.61
Leeward valley	0.74
Trapp	0.92

Winds across the mountain from the opposite direction, that is from the east or southeast, never attain the velocity of winds from a westerly quarter. The record of 23 days in winter and spring with an average velocity of 15.6 miles per hour (6.9 meters per second) give the following gradients:

Windward valley	0.61
Leeward valley	0.45
Trapp	0.45

The above statistics clearly indicate that in the case of westerly winds, which are generally dry winds, the vertical temperature gradient is greatest in the leeward valley. In the case of southeast or east winds, which are uniformly moist winds, the gradient is considerably smaller than that for west winds as might be expected.

Short period temperature in free air.—The work at Mount Weather and in the west has brought to notice a class of temperature changes in the free air of very considerable magnitude which do not find a ready explanation. They have been observed on the continent of Europe, and especially in England. By utilizing the records of temperature made in kite ascents and descents at Mount Weather, on the same day, it is discovered that on some days under certain types of pressure distribution the atmosphere is growing progressively warmer or colder as the case may be. Some of the most striking cases of progressive warming and cooling, respectively, are shown by the flights made on January 4, 20, and 26, February 7 and 26, and December 28, 1910. The general weather conditions on the above-named dates as shown by the Washington daily weather maps are reproduced in this paper and a plot of the temperature conditions both on the ascent and descent of the kite has been added on the right margin of each chart. The full line indicates the ascent and the broken line the descent. The temperatures as abscissæ are plotted against the altitudes as ordinates in the usual manner. In Table VII are given the numerical values of temperature on both the ascent and descent of the kite for the levels of 1,000, 1,500, 2,000, 2,500, and 3,000 meters above sea level, with the times at which the kite meteorograph reached those levels in both ascent and descent. These data afford a means of computing the hourly rate of temperature change in the free air under different weather conditions and show the magnitude of the changes above mentioned. The zones of unequal warming and cooling in the layers of the air below 3 kilometers, which these changes evidently indicate, are not confined to any fixed level, but seem to occur irregularly in practically all levels. Perhaps one of the most general and effective processes by which changes in the temperature of the lower layers of the atmosphere are brought about is by changes in the direction of the lower winds, whereby warm southerly surface winds are replaced by cold northerly winds. The kite flights at Mount Weather in connection with observations on the upper cloud motions clearly show that cyclonic weather is preceded and attended by southerly winds up to altitudes greater than that which can be attained by kites. Figure 25, page 63, this bulletin, Volume IV, Blair—"Three-year summary," shows a southerly component in the wind in cyclones in the few flights in which an altitude of 4,000 meters above sea level was attained. That southerly surface winds at Mount Weather are warm winds there can be no doubt, but the question arises, are similarly directed winds in the free air warm winds? A direct answer to this query is possible by taking out the temperature of each altitude reached according to the direction of the wind, a work which has not yet been done. We can arrive at a close approximation to the desired result in another way. In the three years' summary of kite observations above referred to, Table I gives the mean temperature in the free air above Mount Weather in all sorts of weather conditions, and in Table II these means are grouped by seasons. These data, especially for the lower levels where the observations are fairly numerous, may be considered in the light of normal values. In Volume IV, Table IV, page 36, are given the data of temperatures observed at various levels in the four quadrants of anticyclones and in Table VI, page 39, similar data appear for cyclones. Considering the data in Table I as normal values, we can easily compute the excess or deficiency of temperature, above or below normal, in cyclones and anticyclones for any number of levels the observations will permit. We have computed for the 1,000, 2,000, and 3,000 meter levels (above sea) the departure of the temperature in the several quadrants of anticyclones and cyclones from the so-called normals and the results are graphically shown in figure 1, whence it appears that the warmth of the cyclone practically vanishes at the 3,000-meter level, therefore it is inferred that the southerly winds observed in cyclones at that level are not warm winds. The cold of the anticyclone is well established by these observations in its eastern side and the departures in the 2, 3, and 4 kilometer levels are quite uniform in amount. On the western side of the anticyclone the temperature is in excess of the so-called normals.

The flow of air from the eastern side of the anticyclone, the cold side, into the region of the warmer air of the cyclone is one of the well established principles of air circulation. We will now examine in some detail the results of such flow with the hope that in them we may find an explanation of some of the apparently anomalous temperature conditions disclosed by the kite flights.

Consider first the weather map of January 4, 1910, figure 2, and the temperature diagram for the ascent and descent of the flight made on that date wherein the air column between about 2,300 meters and 800 meters was warmer on the descent than in the ascent, and the maximum amount of warming, about 6° C., occurred at 1,100 meters. On this date the temperature at the top of the flight was −0.7° C.; at the same moment at the surface of the ground at Mount Weather it was −11.3. The winds in both the ascent and descent were between north-northwest and west-northwest, a direction whence cold air comes to Mount Weather. The kite meteorograph did not reach a cloud layer in either the ascent or descent, so that the warming shown at 1,100 meters can not be explained in that way. The kite meteorograph on the previous day was carried to an altitude of 2,889 meters above sea level, where it registered a temperature of −0.3 C., the ground temperature at the same moment being 12.4° C. The top of the flight on the 3d of January was reached at 1.17 p. m.[1] On the following day the top was reached at 10.54 a. m. The effect of diurnal variation at the altitudes in question must be small and may be neglected; the difference in altitude of the two flights being only 4 meters, we may make a direct comparison of the temperature change at the altitude of sea level and at 2,885 meters above. The 24-hour fall in temperature at sea level, 8 a. m. 3d to 8 a. m. 4th, was 24.4° C. At the 2,885-meter level it was 0.4° C., so that the great temperature inversion on January 4, 1910, is explained by the fact that the 24-hour temperature fall was very great in the lower levels but almost nothing aloft. The warming up in the air column between the time of ascent and descent of the kite is not so easily explained. A stratum of air more than 1,000 meters (3,280 feet) in thickness became appreciably warmer in from one to two hours of elapsed time. In the top portion of the flight, that is, between 2,885 and 2,000 meters, the rate of warming was about 0.6° C. per hour; between 2,000 and 1,500 meters it increased to 1.9° C., reaching a maximum at 1,100 meters of 2.3° C. per hour, while on the surface of the mountain the rate was only 0.6° per hour. The kite meteorograph was not in a cloud during the entire flight, nor does it seem probable that the warming was caused by compression in a rapid descent, since a descending current sufficient to cause the observed warming would have been perceptible in its effect on the kites. As no such effect was noticed we must look elsewhere for the cause of the warming. If the wind had been directed from a southerly quarter, we would ascribe the warming to the horizontal transport of warmer air from lower latitudes, but we are unable to account for warm air coming from a northerly quarter.

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[1] This bulletin, Vol. 3, p. 41.

The closer one gets to the actual processes that are going on in the free air, the more puzzling they become at times. The development in the 24 hours following 8 a. m., January 4, was remarkable in that the weak cyclone central over southern Texas (see fig. 2) moved in 24 hours to western Lake Superior, attended by general rains and a surface warming of 20° to 30° F. (11° to 16° C.) over a large extent of country where in the previous 24 hours temperature had fallen about that amount.

The one fact which seems significant in the case of January 4, 1910, is, that, going back to January 3 and the flight on that day, Mount Weather was in a region of low pressure, the center of the latter being over the St. Lawrence Valley. The meteorograph was carried to an altitude of 2,889 meters above sea level, at which point a temperature of −0.3° C. was recorded. By reference to Table I, this bulletin, volume 4, page 32, it will be seen that the average temperature in January at 2,750 meters in 34 flights was −6.6° C., so that the temperature on January 3 at the point reached by the kite meteorograph was more than 6° C. above the mean for the month and altitude. During the 24 hours following the flight of January 3, the temperature in the air layers next to the earth fell markedly, as shown by the map, but as before stated, there was no change of consequence at the 2,889 meter level, consequently the temperature and pressure at that level were favorable to cyclonic development. If we assume that the conditions found to exist at Mount Weather on January 4 prevailed in all parts of the anticyclone of that date, its rapid disintegration and the movement of a cyclone into the region it covered 24 hours previously are more easily understood.

It becomes more and more apparent from such casual observations of the kite flights made at Mount Weather as the writer has been able to make in connection with the movement of cyclones and anticyclones, as depicted on the daily weather maps, that the circulation due to the presence of a cyclone, especially when the barometric minimum of the latter is pronounced, persists in the strata above the level attainable by kites for some time after the barometer has begun to rise and the wind has shifted at the surface. It is unfortunate that kites can not be flown in the cyclonic weather which prevails on Mount Weather. The paucity of flights of any consequence in the different quadrants of cyclones is to us painfully conspicuous in Table VI of the "Three years' summary" hereinbefore quoted.

Continuing on the subject of changes in temperature in the free air, it may be remarked that there must be changes in the lower layers due to the small balance between incoming and outgoing radiation and changes in the absorptivity of the atmosphere due to the presence of fog or cloud. We have observed changes of the latter sort at Mount Weather, as when the mountain top is in full sunshine while the valley stations are under a blanket of cloud or fog. Such conditions do not long persist, but they cause marked differences in the free air temperatures in a horizontal direction and such differences must obtain in the neighborhood of and at the bounding surfaces between regions of complete cloudiness and full sunshine. Another, and probably the most effective cause of changes in the vertical distribution of temperature is those air currents which have ascending or descending motions. The hygrometric state of the air in such currents has much to do with the magnitude of the changes. The existence of local ascending and descending currents, for one seems to be the complement of the other, is manifest by the action of the kites, but not to such an extent as would seem probable. It may be that the horizontal wind, which is nearly always blowing across the mountain, interferes with the formation of vertical currents and that they would be observed in a greater number of cases were the flights made from a valley floor.

On days with ascending currents the decrease of temperature with increase of altitude appears to closely approach the adiabatic rate for dry air, although complete statistics on this point have not yet been compiled. In any event, it does not appear that the changes in temperature in the free air we are considering can be ascribed to ascending or descending currents.

It is a fundamental proposition that the surface air in certain quadrants of the cyclone is of higher temperature than the surrounding air, and we have seen from figure 1 that this excess of temperature can be traced up to 3,000 meters above sea level, hence the source of a portion, at least, of the energy which drives the storm. The writer has elsewhere stated that the rise in temperature in the upper levels in the Rocky Mountain region, in advance of a cyclone, takes place earlier than in the lowlands.[1] The observations made at Mount Weather and valley stations, the difference in altitude being small, close to 1,000 feet (304 meters), show that the high surface temperatures in connection with the advance of cyclonic areas arrive later in the valley than on the mountain top. This fact would suggest the importation of warmer air from lower latitudes, the air at a small distance above the ground moving at a more rapid rate by reason of less friction. On the other hand, when a stratum of cold air is moving along the surface of the earth into regions of relatively higher temperature, its greater specific gravity must impel it to at once seek and fill the valleys and other depressions in the earth's surface, and accordingly no appreciable lag is found between the time of accidental changes to lower temperature on the mountain top as compared with the valley below, as in the case of advancing warm air. Numerous cases of a rise in temperature on Mount Weather before warming up occurs in the valleys are to be found in the records. Particular attention is directed to the weather conditions shown on the daily weather maps of February 7 and 8, 1910. The rise in temperature at Mount Weather and the two valley stations on those dates, in degrees centigrade, were as follows:

	Rise in daily mean temperature.
February 7:	
Mount Weather	2.72
Bentons	1.44
Audley	0.89
February 8:	
Mount Weather	11.39
Bentons	6.83
Audley	8.22

The daily means on the 8th were (degrees centigrade):

Mount Weather	2.17
Bentons	—1.22
Audley	0.61

In the above case the rise in temperature in the free air on the 7th preceded that which occurred between the mountain and valley stations on the 8th, but there does not appear to be any relation between changes of temperature in the free air above Mount Weather and those between Mount Weather and the valley stations. In the remaining cases of marked warming between the time of ascent and descent of the kite, January 20 and 26 and February 7 and 26, 1910, figures 4, 5, 6, and 9, it will be seen that in each case the warming in the free-air column above Mount Weather violates no empirical rule of forecasting for the surface, as did the case of January 4, 1910, before described. In each of the four cases Mount Weather is on the warm side of an anticyclone and a cyclone is central in western districts. In all cases there is a greater or less area of surface warming shown on the map; in one case, the map of February 26, figure 9, the surface warming covers a vast extent of territory. Surface warming is intimately associated with the movement of cyclones; it does not seem improbable that the rise in temperature in the free air may not also be a result of cyclonic circulation.

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[1] This Bulletin, vol. 4, p. 107.

Twenty-four-hour changes in temperature in free air.—The changes in temperature which occur between the times of ascent and descent of the kite are small as compared with those which at times occur in 24 hours as determined by the comparison of the record at a certain level one day with that of the same level for the next day, etc. Perhaps the most striking example that has come to the attention of the writer occurred in the three-day period, February 5–7, 1910. The results appear in tabular form below:

Date.	Time.	Altitude.	Temperature.	Changes in past 24 hours.	
				Aloft.	Surface.
1910.		*Meters.*	°*C.*	°*C.*	°*C.*
Feb. 5	9.20 a. m.	2,000	−15.4	− 9.9	− 2.78
Feb. 6	11.05 a. m.	2,000	−31.4	−16.0	− 9.44
Feb. 7	9.30 a. m.	2,000	−10.0	+21.4	− 3.38
Feb. 8	10.05 a. m.	2,000	− 5.4	+ 4.6	+17.22

During the 24 hours ending with 9.30 a. m., February 7, 1910, a rise in temperature of 21.6° C. occurred at 2,000 meters above sea level, 1,474 meters (4,934.7 feet) above Mount Weather. The daily weather map of February 7, which shows the pressure distribution on the morning of February 7, or the conditions which existed approximately at the close of the 24-hour period, appears as figure 6, to which the reader is referred. The kite flight of the day previous, February 6, 1910, appears in this bulletin, volume 3, page 51, whence it will be seen that the temperature ranged from −11.2° C. (11.8° F.) on the surface to −31.4° C. (−24.5° F.) at 2,037 meters above sea level. The surface isotherms on the weather map of February 7, 1910, omitted from the reproduction for the sake of simplicity, show a tonguelike projection of low temperatures southward from Ontario to the mountains of Virginia. The bending northward of the isobars on figure 6 is clearly due to the low temperatures which prevail over western Ontario and the lower Lake region.

In connection with the temperature change charts of the Forecast Division of the Weather Bureau the writer has noticed that when the temperature is lowered in cold waves below a certain value, say, 30° to 40° F. below the normal for the time and place, there is an immediate tendency toward rising temperature regardless of the pressure distribution or other known precept for a forecast of rising temperature. The thermal conditions of the lower layers of air in a cold wave are not wholly dependent upon the absorption and radiation of heat received directly or indirectly from the sun, but rather upon horizontal differences in pressure which induce strong winds and the latter transport air which has been unduly chilled in a region of high latitude to a region of lower latitude. If the mass of air on the front of a cold wave is inconsiderable as compared with the mass of the atmosphere over the region into which it is projected, it would seem that there would be difficulty in long maintaining in low latitudes the temperature that it originally possessed in high latitudes, and this idea is suggested to account for the remarkable rise from the 6th to the 7th of February at the 2,000-meter level. The temperature of the 6th at the 2,000-meter level was 26.4° C. below the mean for that altitude and season. The surface isotherms on the weather map of February 7 showed that abnormally low temperatures prevailed over a narrow strip of territory that extended southward from Canada. If the upper air temperatures were likewise confined to a narrow band or strip, one easily sees that so great a rise as that reported was merely the return of the air temperature over Mount Weather to equilibrium with its surroundings.

The only case of pronounced cooling in the free air between the time of ascent of the kite and the time of its descent is that of February 21, 1910, figure 8. The cooling in this case can probably be attributed to direct cooling of the air by contact with cold raindrops which began to fall at 12.32 p. m. The kite meteorograph on this date entered a cloud at 12.31 p. m. and did not emerge therefrom until 2 p. m. The temperature within the cloud seems to have been very close to, if not below, the freezing point (32° Fahrenheit, 0° Centigrade) and a coalescence of the cloud particles into raindrops must have taken place at the cloud temperature, which was several degrees lower than that of the air below. Raindrops at a freezing temperature falling through warmer air would doubtless account for the cooling observed on the date in question.

MOUNT WEATHER, VA., *November 10, 1911.*

Table I.—*Mean monthly and annual temperature Fahrenheit.*

Stations.	Years of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Mount Weather	6½	26.2	27.8	36.9	48.3	59.8	67.2	71.3	68.4	62.6	52.5	40.4	31.1	49.4
Trapp	3	30.5	33.1	41.1	52.1	64.4	71.1	74.6	73.0	66.7	56.0	44.3	34.5	53.4
Bentons	2½	30.4	34.5	39.6	51.4	63.2	71.2	75.1	72.3	65.1	53.4	42.8	32.7	52.6
Berryville	3	29.4	32.2	39.6	50.6	62.7	70.1	73.9	72.1	65.0	53.3	42.4	32.7	52.0

Table II.—*Temperature differences, hourly means for six days, between Mount Weather and valley stations—Anticyclonic weather.*

	Bentons, east or south side mountain, 389 meters below Mount Weather.	Audley, west or north side mountain, 374 meters below Mount Weather.	Trapp, foot of mountain, east or south side, 309 meters below Mount Weather.
	° *C.*	° *C.*	° *C.*
1 a. m.	6.56	3.39	−1.61
2 a. m.	7.06	3.50	−0.94
3 a. m.	7.83	4.33	−0.22
4 a. m.	8.06	4.94	0.28
5 a. m.	8.44	5.78	1.22
6 a. m.	8.22	5.83	0.11
7 a. m.	7.56	6.33	0.33
8 a. m.	5.00	5.78	−0.83
9 a. m.	1.56	3.56	−1.50
10 a. m.	−1.39	0.67	−2.11
11 a. m.	−2.50	−1.89	−2.28
Noon	−3.72	−3.89	−2.33
1 p. m.	−4.11	−4.39	−3.00
2 p. m.	−4.17	−3.78	−2.67
3 p. m.	−4.39	−2.39	−2.44
4 p. m.	−4.06	−2.61	−1.94
5 p. m.	−3.72	−3.06	−2.06
6 p. m.	−1.72	−3.44	−1.33
7 p. m.	0.33	−1.50	−0.50
8 p. m.	2.39	0.39	−0.17
9 p. m.	3.33	1.11	−0.56
10 p. m.	4.33	2.11	−0.67
11 p. m.	5.39	3.28	−0.56
Midnight	5.94	3.72	−0.50
Mean	2.17	1.16	1.09
Gradient	−0.56	−0.31	−0.36

Note.—For the hours without sign Mount Weather was warmer than valley stations.

TABLE III.—*Hourly temperature departures from the mean of the 24 hours in Fahrenheit degrees.*

	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	Mean temp.
WINTER.																									
Mount Weather.	−0.9	−1.3	−1.5	−1.7	− 2.0	−2.1	−2.2	−2.2	−1.5	−0.5	0.6	1.7	2.4	3.1	3.4	3.1	2.4	1.6	1.0	0.5	0	−0.3	−0.6	−0.5	29.6
Trapp..........	−1.4	−1.9	−2.2	−2.6	− 2.9	−3.2	−3.4	−3.2	−2.2	−1.0	0.6	.8	3.2	4.1	4.5	4.5	3.4	2.3	1.4	.8	0.1	−0.5	−1.0	−1.2	34.3
Benton's.......	−3.5	−4.0	−3.9	−4.5	− 4.7	−4.8	−4.7	−3.3	−2.0	2.1	3.9	5.5	6.5	6.9	6.8	5.8	4.1	2.2	0.9	− .3	−1.4	−1.9	−2.5	−3.0	31.3
Audley.........	−2.7	−2.4	−3.3	−3.7	− 3.8	−4.0	−4.3	−3.6	−2.2	0	2.4	4.2	5.4	6.2	6.0	6.8	3.7	2.1	1.0	.2	−0.7	−1.3	−1.7	−2.3	32.8
SPRING.																									
Mount Weather.	−3.0	−3.7	−4.3	−4.7	− 5.2	−5.5	−5.0	−3.7	−2.4	0.4	1.5	3.2	4.8	5.8	6.3	6.3	5.7	4.4	2.8	1.4	0.5	−0.4	−1.2	−2.1	50.4
Trapp..........	−3.7	−4.4	−5.0	−5.6	− 6.1	−6.6	−6.0	−3.7	−2.6	−0.6	− .3	3.8	5.5	6.6	7.4	7.3	6.8	5.5	3.4	1.6	0.4	−0.5	−1.5	−2.5	53.6
Benton's.......	−6.8	−7.9	−8.8	−9.7	−10.4	−9.9	−7.4	−3.8	0.2	3.3	5.7	7.6	9.2	10.2	10.6	9.7	8.6	6.5	3.7	1.2	−0.7	−2.5	−3.9	−5.3	54.2
Audley.........	−5.5	−6.5	−7.4	−8.0	− 8.6	−9.1	−7.6	−4.0	−1.6	1.4	4.1	6.4	8.0	9.2	9.4	9.0	8.2	6.4	3.8	1.6	0.1	−1.5	−2.8	−4.2	52.2
SUMMER.																									
Mount Weather.	−2.7	−3.4	−4.1	−4.6	− 5.2	−5.4	−5.1	−3.1	−2.0	−0.1	1.9	3.4	4.7	5.6	5.9	5.4	5.1	3.9	2.4	0.8	0	−0.6	−1.3	−1.9	68.3
Trapp..........	−4.0	−4.5	−5.0	−5.5	− 6.0	−5.8	−4.0	−2.4	−0.7	1.1	3.0	4.5	5.7	6.6	7.0	6.6	6.0	4.5	1.9	0	−1.3	−1.9	−2.7	−3.4	72.6
Benton's.......	−7.0	−7.7	−8.3	−9.0	− 9.3	−8.0	−4.9	−1.3	3.5	4.7	6.4	7.3	8.6	9.2	8.9	7.9	6.7	4.8	4.4	−0.4	−2.3	−3.7	−5.0	−6.0	72.1
Audley.........	−5.6	−6.6	−7.4	−8.2	− 9.0	−7.8	−6.4	−2.7	−0.1	2.6	5.1	7.1	8.2	8.7	8.6	8.0	7.5	6.1	3.6	0.9	−1.0	−2.4	−3.6	−4.4	71.4
AUTUMN.																									
Mount Weather.	−2.1	−2.6	−3.1	−3.6	− 4.0	−4.4	−4.4	−3.3	−2.8	−0.3	1.3	3.1	4.4	5.6	5.7	5.5	4.3	2.5	1.3	0.5	−0.2	−0.8	−1.3	−2.8	52.8
Trapp..........	−3.0	−3.5	−4.0	−4.5	− 5.1	−5.3	−5.3	−3.9	−2.9	0.4	3.6	4.5	6.0	7.0	7.4	6.9	5.1	2.8	3.0	0.1	−0.7	−1.3	−2.9	−2.8	56.5
Benton's.......	−5.4	−6.3	−7.0	−7.5	− 8.0	−8.2	−7.0	−4.2	0.5	3.7	6.0	8.0	8.9	9.6	9.8	8.9	7.1	4.2	1.7	−0.5	−0.3	−0.9	−2.5	−2.4	56.1
Audley.........	−5.1	−5.8	−6.6	−7.2	− 7.9	−8.6	−8.0	−4.6	−1.5	2.1	5.5	7.7	9.5	10.0	9.8	8.9	6.9	4.2	2.0	0.2	−1.1	−2.5	−3.5	−4.5	54.4

TABLE IV.—*Corrections to reduce Mount Weather hourly temperatures to the true daily mean and the level of the valley below, approximately 144 m. above sea level.*

(In degrees Centigrade.)

	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a .	Noon.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	Mean.
WINTER.																									
Mount Weather .	+1.83	+2.06	+2.17	+2.28	+2.44	+2.50	+2.56	+2.56	+2.17	+1.61	+1.00	+0.39	0.00	−0.39	−0.56	−0.39	0.00	+0.44	+0.78	+1.06	+1.33	+1.50	+1.67	+1.61	+1.26
SPRING.																									
Trapp..........	+3.22	+3.61	+3.94	+4.17	+4.44	+4.61	+4.33	+3.61	+2.89	+1.33	+0.72	−0.22	−1.11	−1.67	−1.94	−1.94	−1.61	−0.89	0.00	+0.78	+1.28	+1.78	+2.22	+2.72	+1.67
SUMMER.																									
Benton's	+3.39	+3.78	+4.17	+4.44	+4.78	+4.89	+4.72	+3.61	+3.00	+1.83	+0.83	0.00	−0.72	−1.22	−1.39	−1.11	−0.94	−0.28	+0.56	+1.44	+1.89	+2.22	+2.61	+2.94	+1.89
AUTUMN.																									
Audley..........	+2.50	+2.78	+3.06	+3.33	+3.56	+3.78	+3.78	+3.17	+2.89	+1.50	+0.61	−0.39	−1.11	−1.78	−1.83	−1.72	−1.06	−0.06	+0.61	+1.06	+1.44	+1.78	+2.06	+2.89	+1.34

TABLE V.—*Seasonal temperature gradients, clear weather, between valley stations and Mount Weather, difference in altitude about 380 meters (1,247 feet).*

[Gradients expressed in degrees centigrade per 100 meters. Minus signs indicate negative gradients.]

	Benton's, eastern valley.				Audley, western valley.			
	Winter.	Spring.	Summer.	Autumn.	Winter.	Spring.	Summer.	Autumn.
Number of days record	28	23	22	27	28	23	22	27
1 a. m	0.03	−0.14	−0.11	−0.03	0.10	−0.02	−0.21	−0.08
2 a. m	−0.07	−0.26	−0.20	−0.05	0.09	−0.18	−0.33	−0.10
3 a. m	−0.07	−0.21	−0.31	−0.14	0.13	−0.13	−0.33	−0.21
4 a. m	−0.13	−0.27	−0.21	−0.19	0.00	−0.15	−0.34	−0.21
5 a. m	−0.10	−0.40	−0.17	−0.16	0.03	−0.27	−0.39	−0.19
6 a. m	−0.03	−0.31	−0.04	−0.17	−0.05	−0.31	−0.21	−0.27
7 a. m	−0.03	0.04	0.26	0.00	−0.05	0.08	0.09	0.03
8 a. m	0.04	0.47	0.73	0.40	−0.08	0.43	0.48	0.48
9 a. m	0.56	0.97	1.10	1.07	0.27	0.67	0.86	0.74
10 a. m	0.88	1.08	1.23	1.31	0.49	0.74	1.01	0.97
11 a. m	1.10	1.04	1.23	1.31	0.67	0.74	1.03	1.04
Noon	1.14	1.08	1.13	1.24	0.76	0.74	0.92	1.00
1 p. m	1.13	0.97	1.04	1.17	0.88	0.74	0.91	0.95
1 p. m	1.10	0.97	1.08	1.07	0.86	0.79	1.06	0.91
2 p. m	0.97	0.93	1.07	1.08	0.76	0.76	0.98	0.86
3 p. m	0.83	0.90	0.94	0.96	0.63	0.76	0.98	0.65
4 p. m	0.61	0.90	0.93	0.77	0.37	0.78	0.90	0.54
5 p. m	0.37	0.84	0.84	0.56	0.25	0.67	0.85	0.34
6 p. m	0.19	0.59	0.60	0.29	0.12	0.55	0.61	0.28
7 p. m	0.04	0.36	0.36	0.07	0.16	0.39	0.37	0.10
8 p. m	−0.09	0.17	0.13	−0.07	0.09	0.31	0.19	0.03
90 p. m	−0.14	−0.02	−0.04	−0.20	−0.06	0.33	0.00	0.06
11 p. m	−0.17	−0.17	−0.17	−0.29	−0.03	0.12	−0.08	0.07
Midnight	−0.17	−0.29	−0.14	−0.46	−0.08	−0.22	−0.13	−0.02
Mean	0.33	0.38	0.47	0.40	0.26	0.34	0.38	0.33

TABLE VI.—*Seasonal temperature gradients, cloudy weather, between valley stations and Mount Weather, difference in altitude about 380 meters (1,247 feet).*

[Gradients expressed in degrees centigrade per 100 meters. All signs are positive.]

	Bentons, eastern valley.				Audley, western valley.			
	Winter.	Spring.	Summer.	Autumn.	Winter.	Spring.	Summer.	Autumn.
Number of days record	28	23	22	27	28	23	22	27
1 a. m	0.17	0.06	0.41	0.21	0.03	0.06	0.36	0.34
2 a. m	0.16	0.10	0.39	0.21	0.09	0.12	0.30	0.25
3 a. m	0.10	0.16	0.44	0.19	0.06	0.19	0.39	0.24
4 a. m	0.11	0.04	0.41	0.19	0.06	0.18	0.36	0.25
5 a. m	0.13	0.08	0.31	0.22	0.08	0.27	0.39	0.25
6 a. m	0.15	0.24	0.53	0.27	0.13	0.18	0.42	0.27
7 a. m	0.16	0.30	0.71	0.47	0.13	0.16	0.58	0.36
8 a. m	0.23	0.54	0.80	0.43	0.22	0.33	0.73	0.57
9 a. m	0.34	0.82	1.10	0.70	0.28	0.55	0.91	0.79
10 a. m	0.43	0.79	1.10	0.97	0.37	0.81	0.97	1.00
11 a. m	0.50	0.97	1.06	1.08	0.43	0.93	1.03	1.27
Noon	0.57	1.00	1.14	1.13	0.52	0.97	1.13	0.96
1 p. m	0.57	1.01	1.07	1.04	0.45	1.07	1.08	1.00
2 p. m	0.60	0.99	1.01	0.97	0.57	0.98	1.15	0.85
3 p. m	0.63	1.20	0.93	0.97	0.57	0.78	0.96	0.94
4 p. m	0.63	0.85	0.86	0.92	0.57	0.80	0.93	0.78
5 p. m	0.49	0.50	0.80	0.82	0.40	0.61	0.93	0.62
6 p. m	0.43	0.44	0.82	0.77	0.31	0.58	0.99	0.66
7 p. m	0.39	0.56	0.74	0.60	0.29	0.64	0.81	0.66
8 p. m	0.21	0.39	0.60	0.70	0.18	0.48	0.61	0.61
9 p. m	0.37	0.36	0.53	0.64	0.25	0.50	0.54	0.58
10 p. m	0.36	0.30	0.47	0.61	0.25	0.42	0.43	0.56
11 p. m	0.26	0.33	0.40	0.57	0.13	0.43	0.34	0.48
Midnight	0.22	0.46	0.39	0.53	0.11	0.54	0.30	0.43
Mean	0.34	0.52	0.71	0.68	0.27	0.52	0.69	0.61

TABLE VII.—*Changes in temperature between time of ascent and time of descent on the dates enumerated.*

Date and altitude.	Ascent.		Descent.		Difference.	Time elapsed.	Hourly rate.
	Time.	Temperature.	Time.	Temperature.			
Jan. 4, 1910:		°C.		°C.	°C.	H. m.	°C.
526 meters	9.13 a. m.	−12.1	12.09 p. m.	−10.2	1.9	2 56	0.6
1,000 meters	9.25 a. m.	−14.4	11.56 a. m.	−8.7	5.7	2 31	2.3
1,500 meters	9.56 a. m.	−5.9	11.49 a. m.	−4.1	1.8	1 53	1.0
2,000 meters	10.23 a. m.	−2.5	11.38 a. m.	−1.7	0.8	1 15	0.6
2,500 meters	10.48 a. m.	0.1	11.04 a. m.	−0.1	−0.2	0 16	−0.7
Jan. 20, 1910:							
526 meters	9.15 a. m.	7.0	1.12 p. m.	7.0	0.0	3 57	0.0
1,000 meters	9.49 a. m.	6.1	12.59 p. m.	10.5	4.5	3 10	1.4
1,500 meters	10.14 a. m.	5.8	12.43 p. m.	7.1	1.3	2 29	0.5
2,000 meters	10.38 a. m.	2.8	12.31 p. m.	4.3	1.5	1 53	0.8
2,500 meters	11.40 a. m.	0.6	12.05 p. m.	1.0	0.4	0 25	1.0
Jan. 26, 1910:							
526 meters	8.58 a. m.	−4.4	2.47 p. m.	−2.9	1.5	5 49	0.3
1,000 meters	9.12 a. m.	3.4	2.35 p. m.	8.1	4.7	5 23	0.9
1,500 meters	9.40 a. m.	3.0	2.16 p. m.	4.4	1.4	4 36	0.3
2,000 meters	10.12 a. m.	−1.0	1.43 p. m.	2.0	3.0	3 31	0.9
2,500 meters	10.31 a. m.	−3.8	1.08 p. m.	−1.1	2.7	2 37	1.0
3,000 meters	10.51 a. m.	−4.7	12.41 p. m.	−4.1	0.6	1 50	0.4
3,500 meters	11.14 a. m.	−5.1	12.20 p. m.	−5.8	−0.7	1 06	−0.6
4,000 meters	11.34 a. m.	−8.4	11.41 a. m.	−8.5	−0.1	0 07	−0.8
Feb. 7, 1910:							
526 meters	8.49 a. m.	−15.1	12.21 p. m.	−8.1	7.0	3 32	2.0
1,000 meters	8.58 a. m.	−16.9	12.15 p. m.	−10.7	6.2	3 17	1.9
1,500 meters	9.12 a. m.	−11.2	12.11 p. m.	−7.7	3.5	2 59	1.2
2,000 meters	9.31 a. m.	−9.9	11.51 a. m.	−7.2	2.7	2 20	1.1
2,500 meters	9.43 a. m.	−8.6	11.32 a. m.	−7.2	1.4	1 49	0.8
3,000 meters	10.06 a. m.	−10.4	10.27 a. m.	−10.1	0.3	0 21	0.9
Feb. 8, 1910:							
526 meters	8.38 a. m.	1.8	3.38 p. m.	2.6	0.8	7 00	0.1
1000 meters	9.01 a. m.	1.5	3.29 p. m.	1.3	−0.2	6 28	−0.03
1500 meters	9.30 a. m.	−1.7	3.20 p. m.	−2.8	−1.1	5 50	−0.2
2000 meters	10.04 a. m.	−5.3	3.10 p. m.	−5.4	−0.1	5 06	0.02
2500 meters	10.57 a. m.	−7.9	2.37 p. m.	−7.7	0.2	3 40	0.05
3000 meters	11.21 a. m.	−10.3	2.03 p. m.	−9.8	0.5	2 42	0.2
3500 meters	11.53 a. m.	−13.0	12.33 p. m.	−12.9	0.1	0 40	0.1
Feb. 21, 1910:							
526 meters	11.40 a. m.	10.4	3.44 p. m.	8.0	−2.4	4 04	−0.6
1,000 meters	12.00 m.	8.1	3.23 p. m.	4.8	−3.3	3 23	−1.0
1,500 meters	12.17 p. m.	6.3	2.53 p. m.	1.5	−4.8	2 36	−1.8
2,000 meters	12.33 p. m.	3.1	2.33 p. m.	−0.8	−3.9	2 00	−1.9
2,500 meters	12.49 p. m.	−0.3	2.10 p. m.	−1.4	−1.1	1 21	−0.8
3,000 meters	1.01 p. m.	−2.6	1.41 p. m.	−2.4	0.2	0 40	0.3
Feb. 26, 1910:							
526 meters	7.39 a. m.	−9.0	12.31 p. m.	−1.4	7.6	4 52	1.6
1,000 meters	7.52 a. m.	−3.9	12.10 p. m.	0.4	4.3	4 18	1.0
1,500 meters	8.14 a. m.	−1.4	11.48 a. m.	2.3	3.7	3 34	1.0
2,000 meters	8.31 a. m.	0.5	11.35 a. m.	2.0	1.5	3 04	0.5
2,500 meters	8.46 a. m.	−1.3	11.28 a. m.	−1.4	−0.1	2 42	−0.04
3,000 meters	9.11 a. m.	−4.2	11.23 a. m.	−5.5	−1.3	2 12	−0.6
3500 meters	9.30 a. m.	−6.9	10.39 a. m.	−7.5	−0.6	1 39	−0.4
4000 meters	9.49 a. m.	−9.6	9.53 a. m.	−9.6	0.0	0 04	0.0
Dec. 13, 1910:							
526 meters	8.36 a. m.	−9.6	12.49 p. m.	−6.0	3.6	4 13	0.9
1,000 meters	8.49 a. m.	−8.5	12.31 p. m.	−6.8	1.7	3 42	0.5
1,500 meters	9.27 a. m.	−6.1	12.16 p. m.	−4.7	1.4	2 49	0.5
2,000 meters	9.57 a. m.	−8.5	12.08 p. m.	−7.4	1.1	2 11	0.5
2,500 meters	10.12 a. m.	−12.3	11.59 a. m.	−10.8	1.5	1 47	0.8
3,000 meters	10.44 a. m.	−15.3	11.45 a. m.	−13.7	1.6	1 01	1.6
3,500 meters	11.08 a. m.	−16.4	11.23 a. m.	−16.1	0.3	0 15	1.2
Dec. 14, 1910:							
526 meters	8.51 a. m.	−3.8	12.17 p. m.	−0.8	3.0	3 26	0.9
1,000 meters	9.04 a. m.	−0.7	12.09 p. m.	0.9	1.6	3 05	0.5
1,500 meters	9.18 a. m.	−2.0	11.48 a. m.	2.8	4.8	2 30	1.9
2,000 meters	9.33 a. m.	0.8	11.33 a. m.	0,9	0.1	2 00	0.05
2,500 meters	9.47 a. m.	−2.7	11.20 a. m.	−2.1	0.6	1 33	0.4
3,000 meters	10.04 a. m.	−5.8	11.05 a. m.	−5.1	0.7	1 01	0.7
3,500 meters	10.25 a. m.	−8.5	10.47 a. m.	−8.1	0.4	0 22	1.1
Dec. 28, 1910:							
526 meters	8.16 a. m.	0.0	11.56 a. m.	2.2	2.2	3 40	0.6
1,000 meters	8.22 a. m.	5.9	11.47 a. m.	10.1	4.2	3 25	1.2
1,500 meters	8.37 a. m.	6.3	11.30 a. m.	7.3	1.0	2 53	0.3
2,000 meters	8.51 a. m.	2.8	11.13 a. m.	4.3	1.5	2 22	0.6
2,500 meters	9.13 a. m.	−0.4	10.48 a. m.	0.6	1.0	1 35	0.6
3,000 meters	9.36 a. m.	−3.0	10.10 a. m.	−3.3	−0.3	0 34	−0.5
3,500 meters	9.44 a. m.	−2.6	9.48 a. m.	−2.2	0.4	0 04	6.0

TABLE VII.—*Changes in temperature between time of ascent and time of descent on the dates enumerated*—Continued.

Date and altitude.	Ascent.		Descent.		Difference.	Time elapsed.	Hourly rate.
	Time.	Temperature.	Time.	Temperature.			
Jan. 8, 1911:		*°C.*		*°C.*	*°C.*	*H. m.*	*°C.*
526 meters	8.12 a. m.	3.2	1.28 p. m.	3.2	0.0	5 16	0.0
1,000 meters	8.24 a. m.	2.9	1.15 p. m.	3.7	0.8	4 51	0.2
1,500 meters	8.37 a. m.	− 1.0	1.05 p. m.	0.4	1.4	4 28	0.3
2,000 meters	8.59 a. m.	− 4.3	12.46 p. m.	− 1.3	3.0	3 47	0.8
2,500 meters	9.29 a. m.	− 7.1	12.22 p. m.	− 4.1	3.0	2 53	1.0
3,000 meters	9.43 a. m.	− 8.9	12.12 p. m.	− 7.3	1.6	2 29	0.6
3,500 meters	9.54 a. m.	−10.6	11.55 a. m.	−10.5	0.1	2 01	0.05
4,000 meters	10.31 a. m.	−13.6	11.17 a. m.	−13.6	0.0	0 46	0.0
Jan. 11, 1911:							
526 meters	8.02 a. m.	9.0	10.58 a. m.	10.2	1.2	2 56	0.4
1000 meters	8.12 a. m.	9.7	10.52 a. m.	8.7	−1.0	2 40	−0.4
1500 meters	8.22 a. m.	6.8	10.41 a. m.	5.5	−1.3	2 19	−0.6
2000 meters	8.34 a. m.	3.7	10.25 a. m.	4.0	0.3	1 51	0.2
2500 meters	9.08 a. m.	7.6	10.03 a. m.	8.1	0.5	0 55	0.5
Feb. 13, 1911:							
526 meters	8.24 a. m.	1.1	12.47 p. m.	7.2	6.1	4 23	1.4
1,000 meters	8.37 a. m.	3.6	12.40 p. m.	4.8	1.2	4 03	0.3
1,500 meters	8.48 a. m.	4.5	12.34 p. m.	6.5	2.0	3 46	0.5
2,000 meters	9.01 a. m.	2.6	12.21 p. m.	7.0	4.4	3 20	1.3
2,500 meters	9.20 a. m.	3.0	12.07 p. m.	5.0	2.0	2 47	0.7
3,000 meters	9.40 a. m.	2.0	11.49 a. m.	1.6	−0.4	2 09	−0.2
3,500 meters	9.55 a. m.	− 1.2	11.28 a. m.	− 1.6	−0.4	1 33	−0.3
4,000 meters	10.13 a. m.	− 3.9	10.53 a. m.	− 3.9	0.0	0 40	0.0

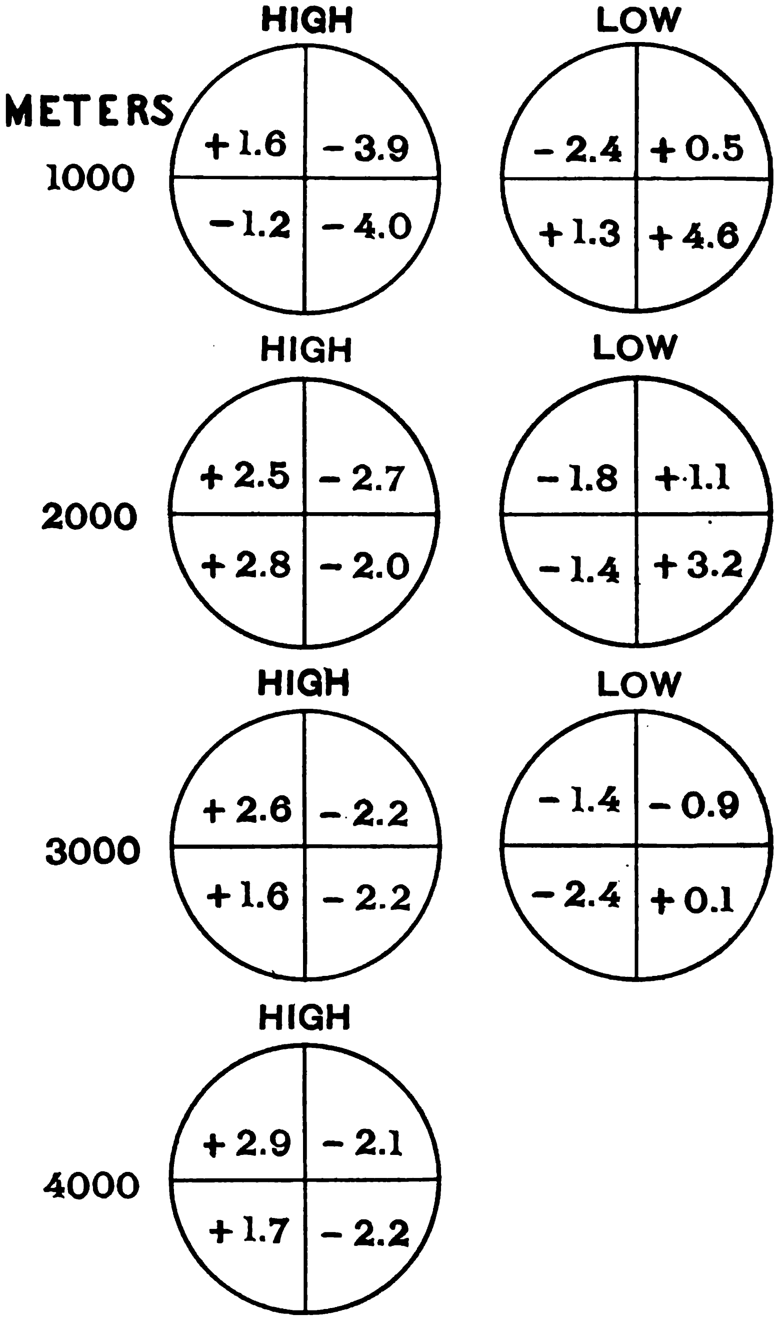

FIG. 1.- Temperature departures in highs and lows - Winter.

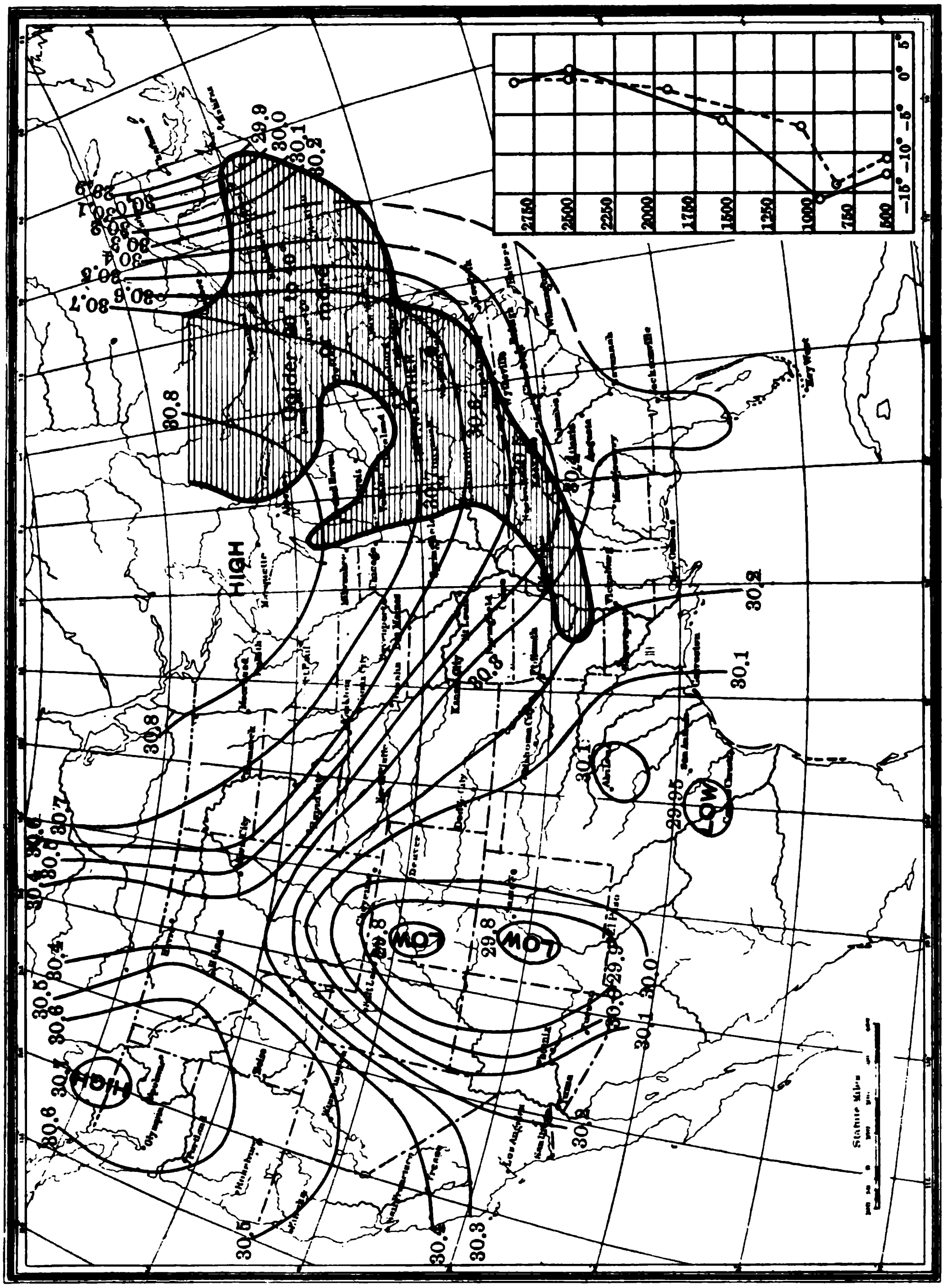

FIG. 2.—Daily weather map, Jan. 4, 1910, with plot of kite flight: Ascent ——; descent . . . .

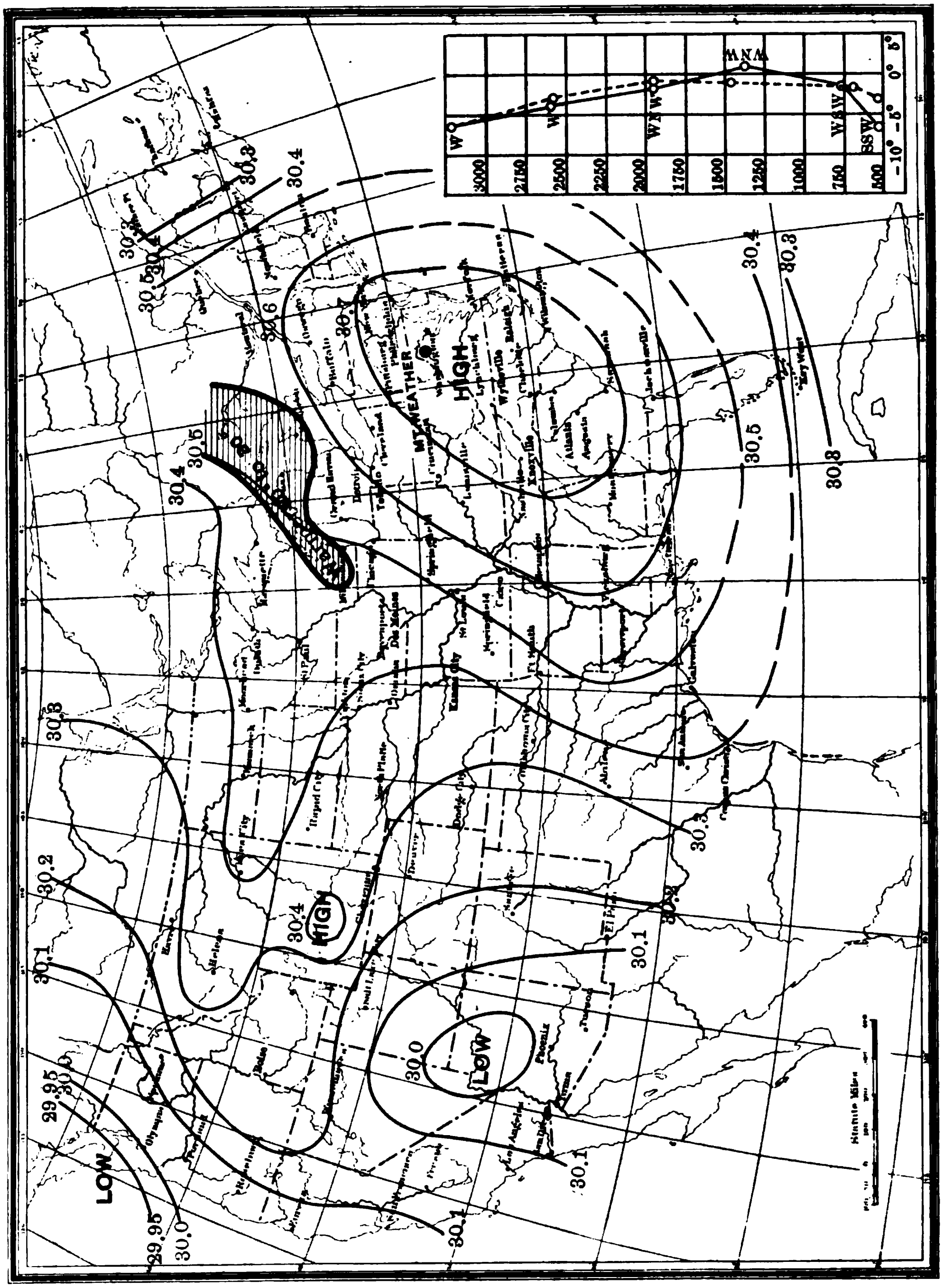

FIG. 3.—Daily weather map, Jan. 11, 1910, with plot of kite flight: Ascent ——; descent .... Surface warming without a Low.

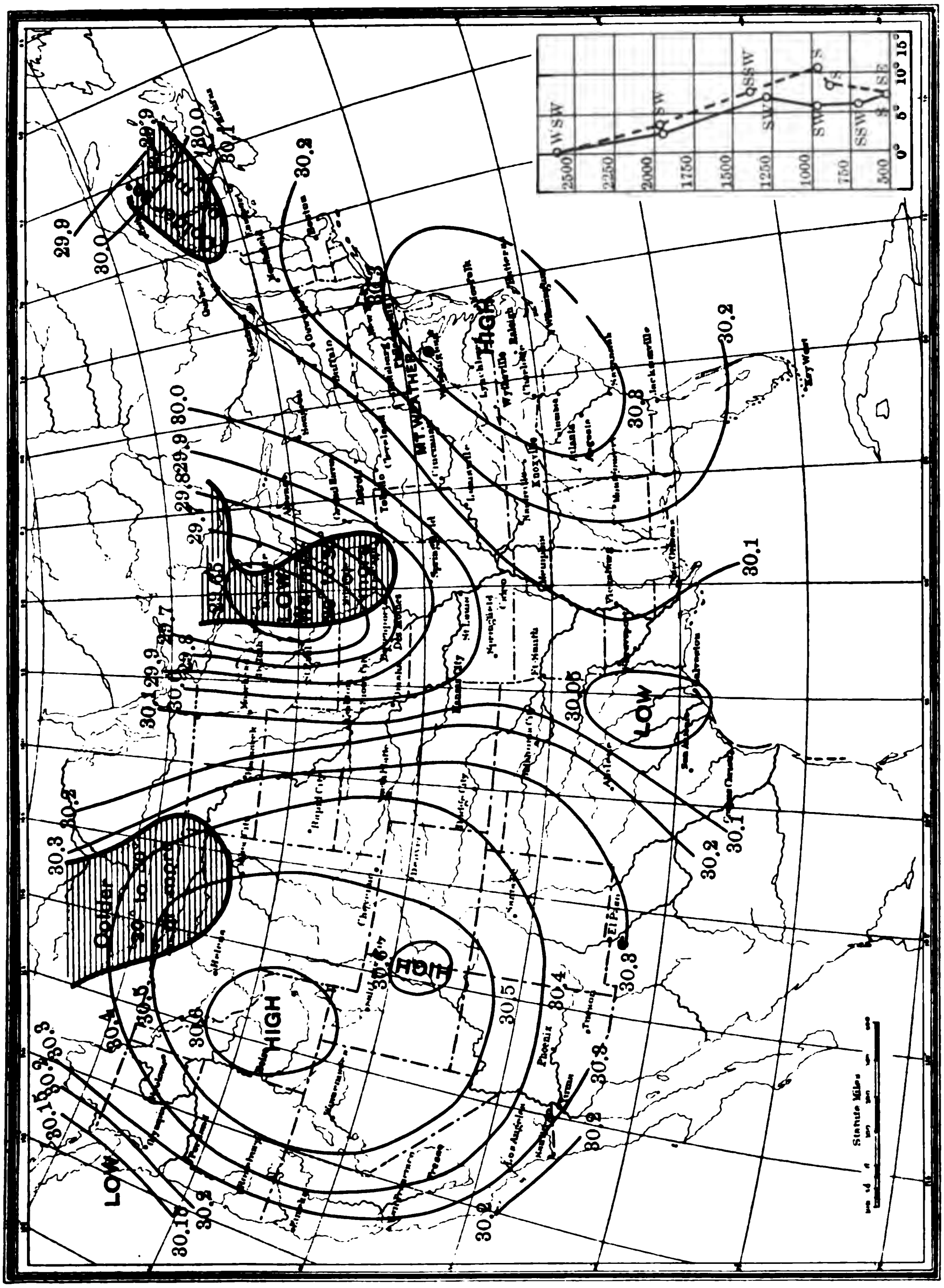

FIG. 4.—Daily weather map, Jan. 20, 1910, with plot of kite flight: Ascent——; descent.....

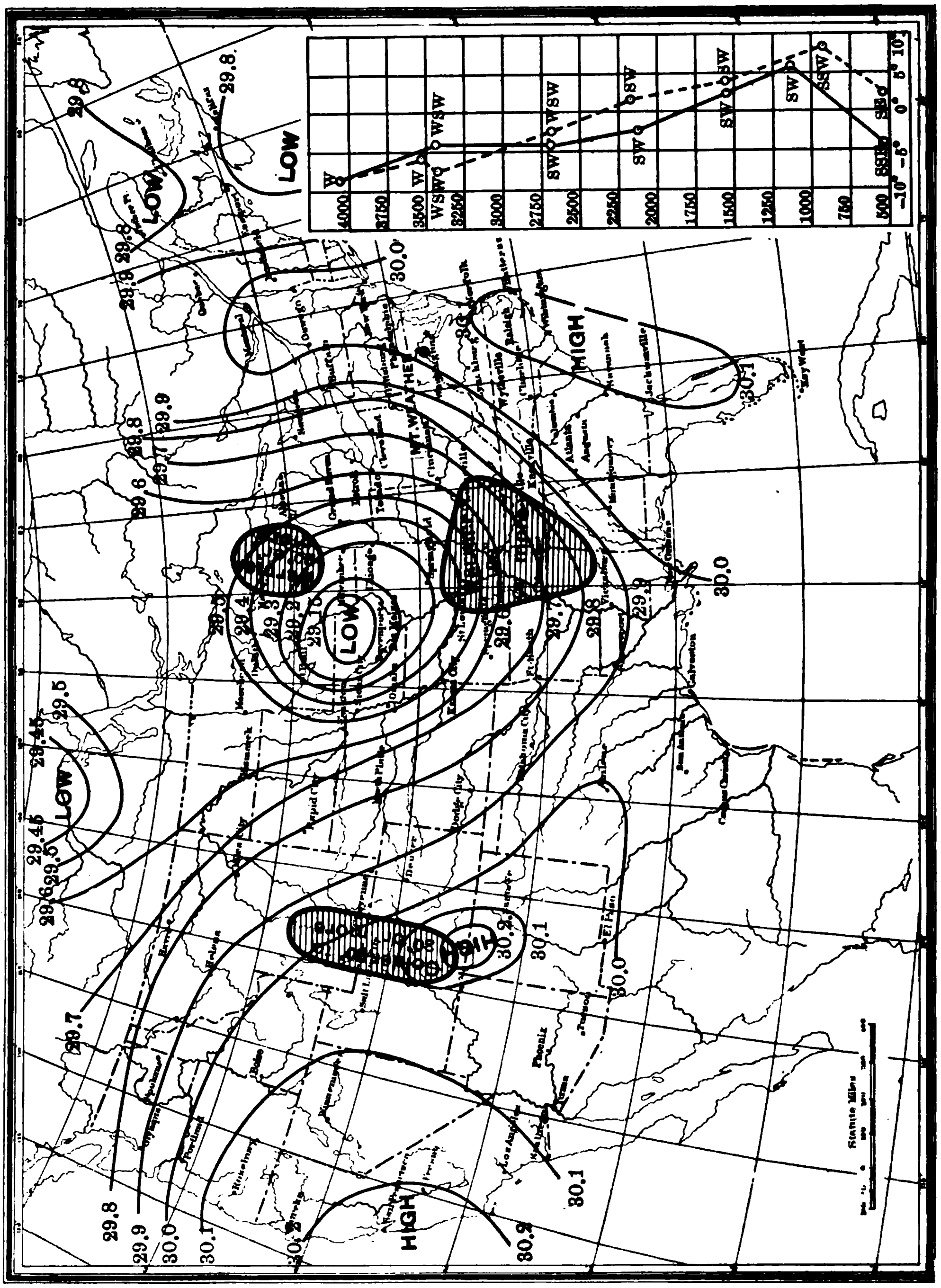

FIG. 5.—Daily weather map, Jan. 26, 1910, with plot of kite flight: Ascent- —; descent....

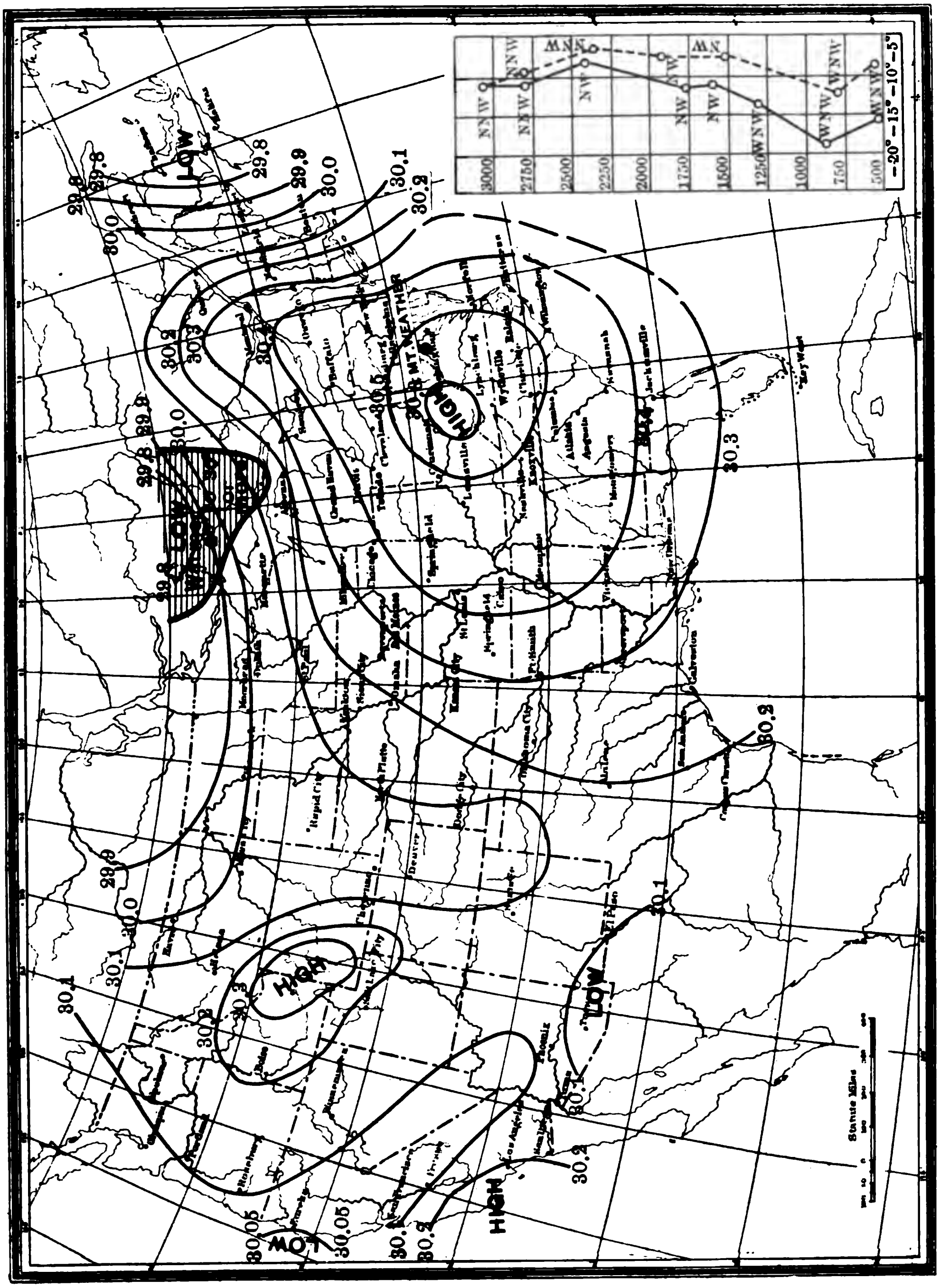

FIG. 6.—Daily weather map, Feb. 7, 1910, with plot of kiteflight: Ascent ——; descent . . . .

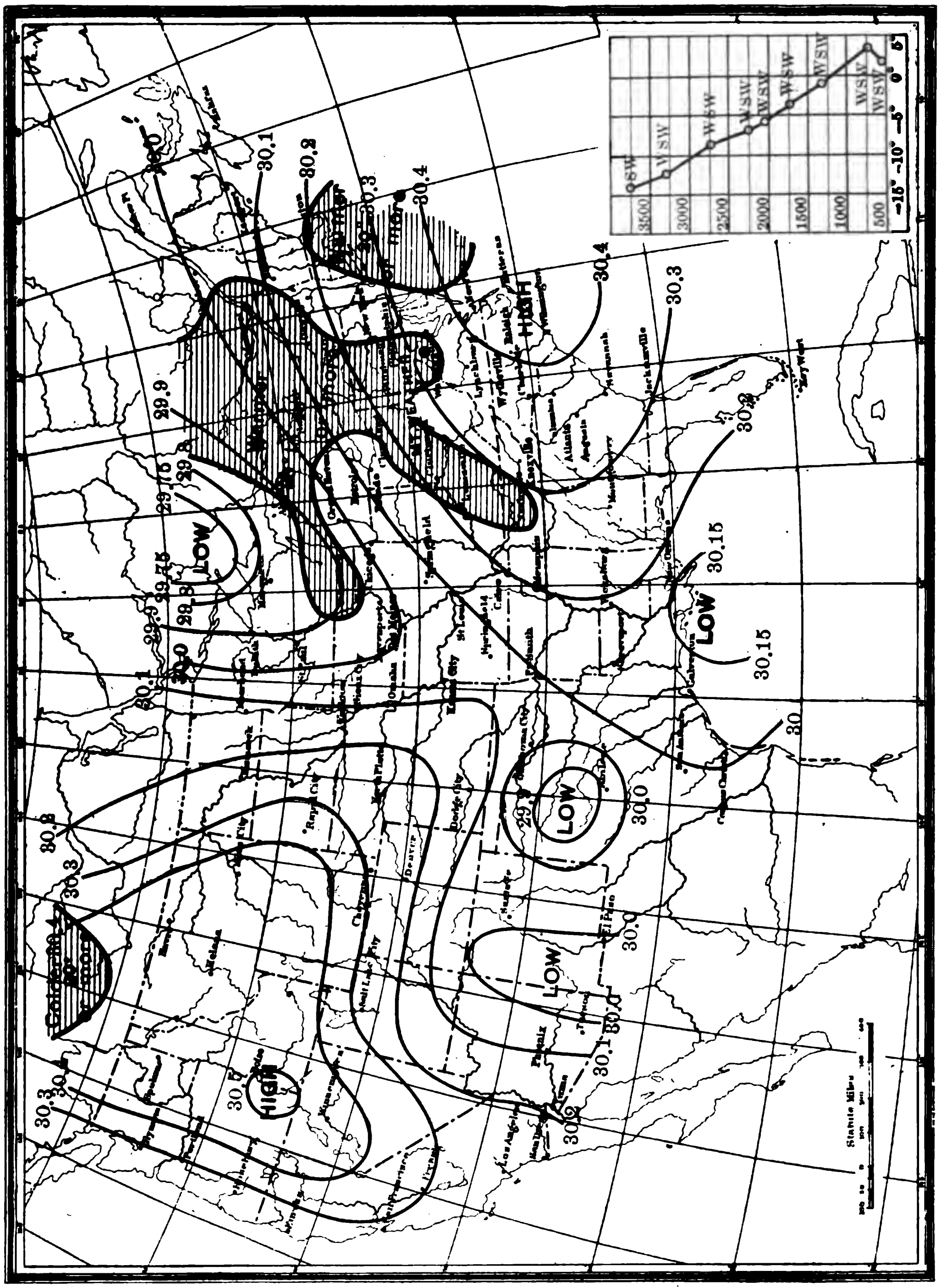

FIG. 7.- Daily weather map, Feb. 8, 1910, with plot of kite flight: Ascent-

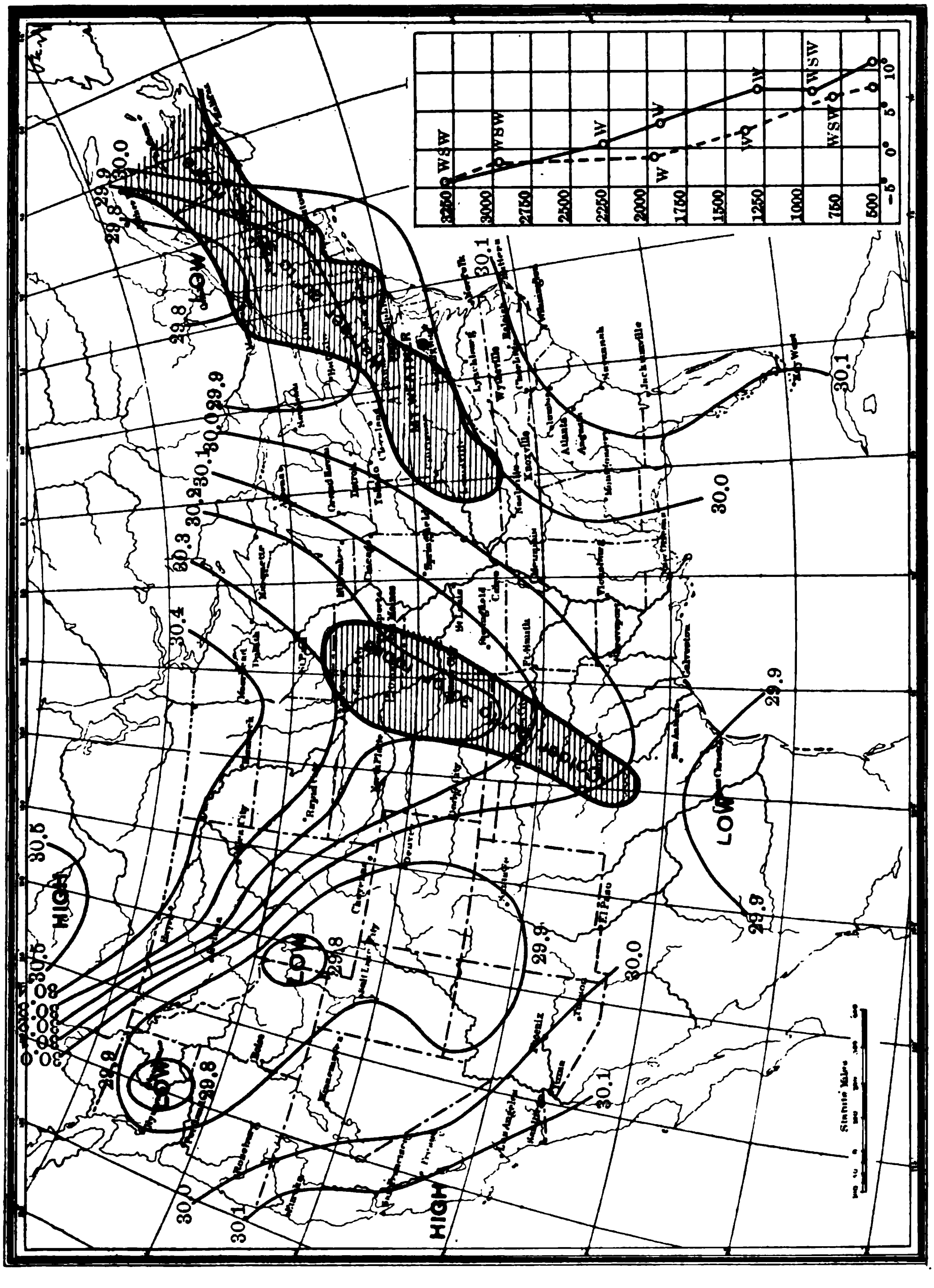

FIG. 8.—Daily weather map, Feb. 21, 1910, with plot of kite flight: Ascent——; descent....

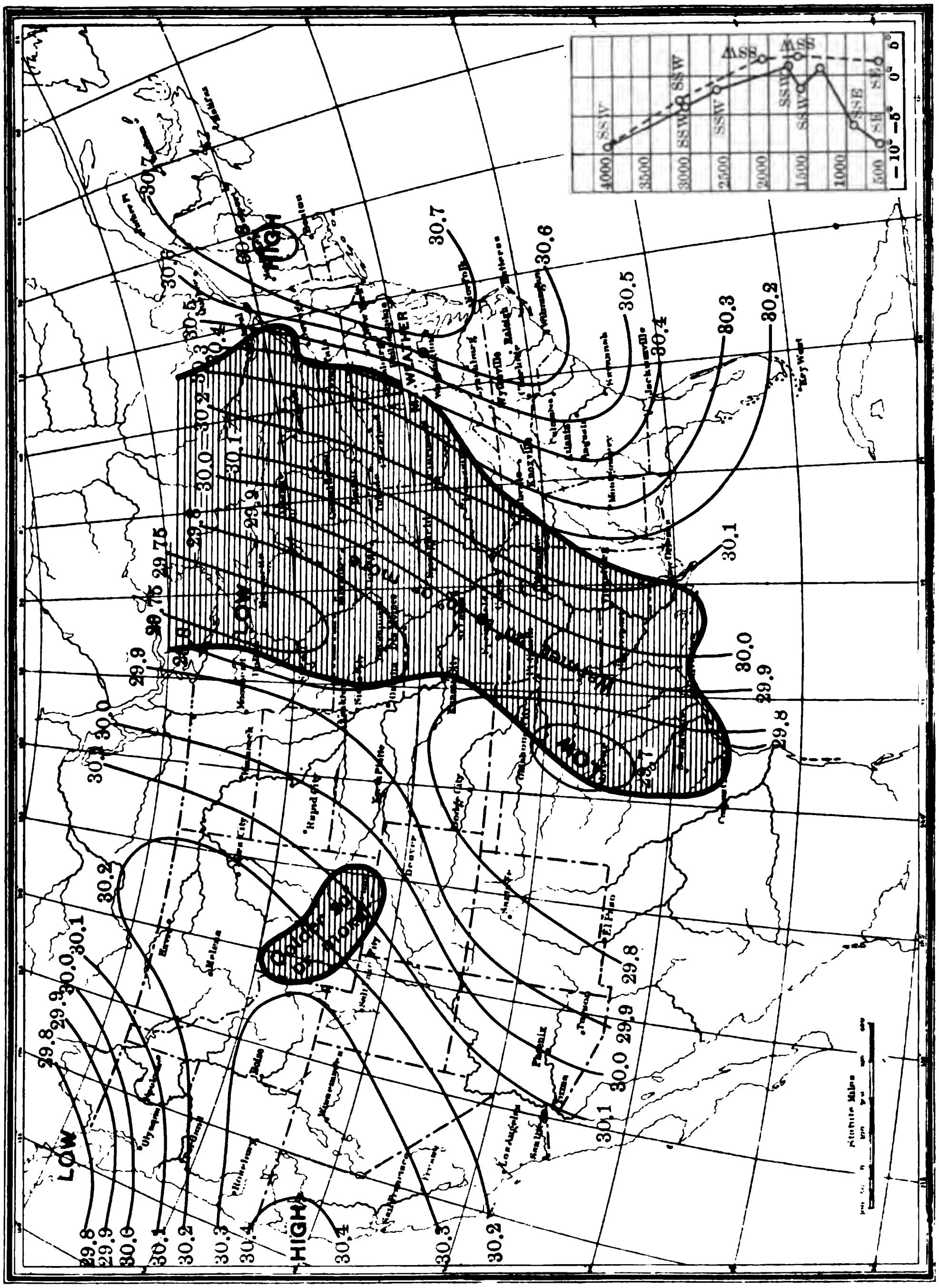

FIG. 9. Daily weather map, Feb. 26, 1910, with plot of kite flight: Ascent——; descent....

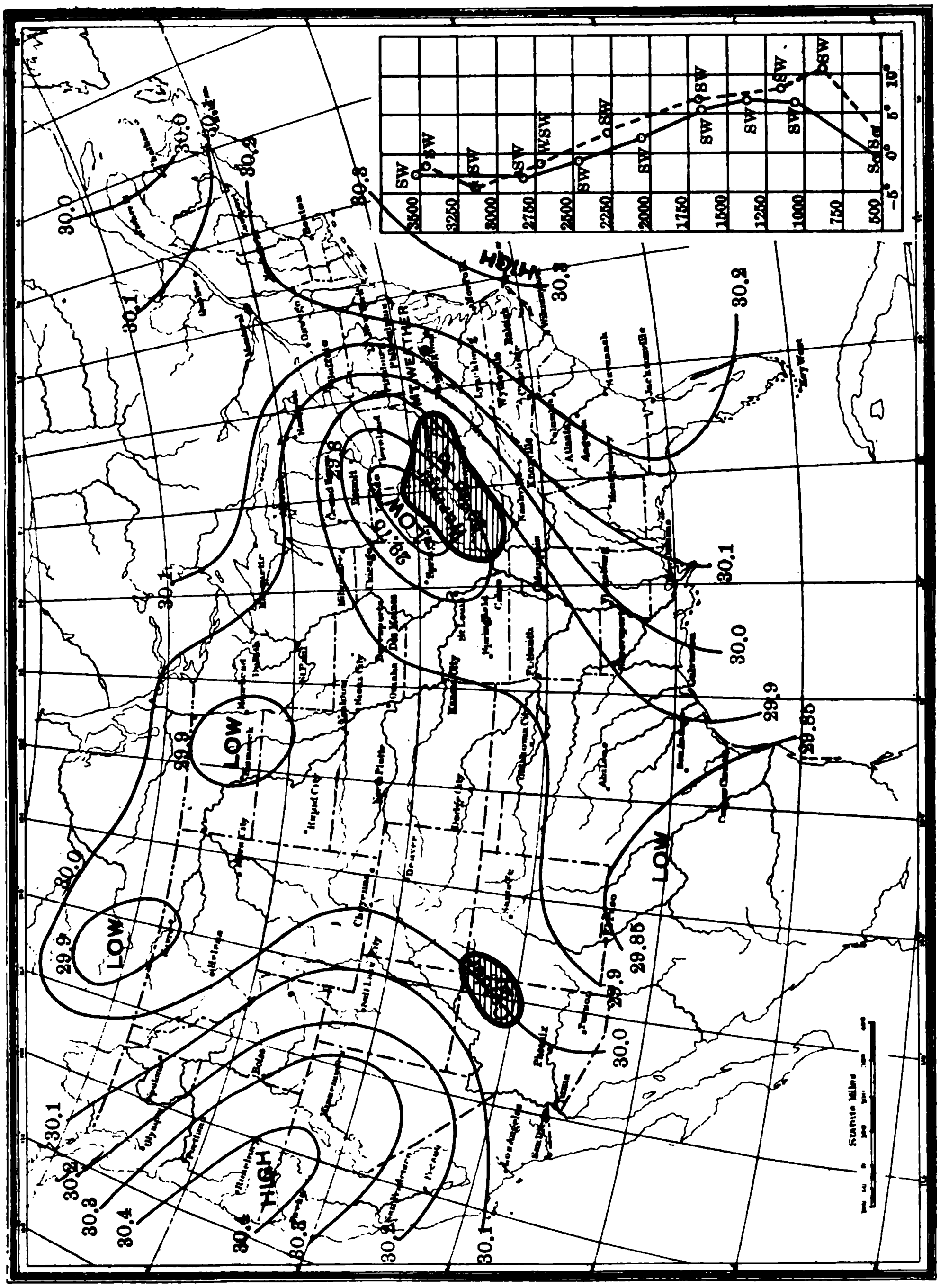

FIG. 10.—Daily weather map, Dec. 28, 1910, with plot of kite flight: Ascent——; descent....

(XIX) FREE AIR DATA AT MOUNT WEATHER FOR JULY, AUGUST, AND SEPTEMBER, 1911.

By the Aerial Section, Wm. R. Blair in Charge.

In this period of 92 days 112 free air observations were made at Mount Weather. Of these, 73 were made by means of kites and 39 by means of captive balloons. The means of the highest points reached daily with the kites was 2,850 meters above sea level in July, 2,536 in August, 3,312 in September, and 2,914 in the period. Similar means for the captive balloon ascensions were 2,027, 1,959, 1,901, and 1,968 meters above sea level, respectively. The highest kite flight of the period, 5,371 meters above sea level, was made on September 21, and the highest balloon ascension, 2,524 meters above sea level, was made on August 21.

The prevailing surface wind direction was west in July, southeast in August, and northwest in September. The mean wind velocity was 5.1 meters per second in July, 5.5 in August, 5.8 in September, and 5.5 in the period. The prevailing wind directions for these months are the same as those of last year, as is also the mean wind velocity for the period. The kite flights of the period are higher than they were last year, and the balloon ascensions are lower.

The charts of the free air isotherms, XIII to XVIII, inclusive, show the rise and fall, at all levels reached, of the isotherms as the minima and maxima, respectively, of surface air pressure pass the base station. The difference in temperature between the warmer ascending air column over falling surface air pressure and the colder descending air column over rising surface air pressure does not appear to be nearly so great in the summer as in the winter months. These temperature differences, as shown in the winter charts, constitute their most characteristic feature. The diurnal rise and fall of temperature is relatively more prominent in the summer charts, but in the summer months the diurnal barometric change is also relatively greater, other barometric changes at the earth's surface considered. Additional data, the simultaneous wind velocities in meters per second at the surface and at the highest point reached, have been entered in Charts XIII to XVIII.

THE CHARTS OF FREE AIR ISOTHERMS.

The data shown by the charts of free air isotherms have been increased from time to time, the method of representing each additional datum being described at the time of its addition. It is thought advisable at this time to collect the description of the charts for more convenient reference.

When the record of the meteorograph for any ascension has been interpreted by comparison with a record of the same meteorograph made in the calibrating chamber, and by the computation of the altitudes from the pressures recorded, a plot of the vertical temperature gradient is made. The altitudes of the even temperatures are taken from this plot and put on the chart of free air isotherms under the date on which the ascension was made. The black crosses on the charts represent the even temperatures, and the black lines are drawn as smoothly as possible through crosses indicating the same temperatures. Whenever interpolations for a longer time than from one day to the next have to be made, dashes instead of solid black lines represent the free air isotherms. The hourly temperatures at the surface are also used in drawing the isotherms. The data are, of course, not a sufficient basis for the correct representation of the diurnal changes in temperature, but the temperature change from day to day and the relation between free air temperatures and surface air pressure are fairly well shown.[1]

The red braces mark inversions of temperature. The lower end of the brace is placed at a minimum of temperature and the upper end at the first point above where the same temperature is found. All temperatures included by the brace are higher than those at either end. The level at which the maximum temperature of the inversion occurs is pointed out by an arrow and marked with the maximum temperature.[2]

The highest point reached in an ascension is marked with a red (T).[3]

The arrows in red at the bottom of the chart indicate maxima and minima of surface air pressure. The arrows pointing up indicate low pressure; those pointing down, high pressure. Incidentally each arrow points the direction of the vertical component of the air's motion in the region between itself and the preceding arrow.[4]

Clouds into or through which the meteorograph was carried in an ascension are marked by means of a red line on which is written in red the amount and kind of clouds. The red line indicates as nearly as possible the level at which the kite or balloon carrying the meteorograph disappeared in the clouds. It is not always easy to represent the cloud level since it often (especially when the clouds are of the stratus types) rises or lowers markedly during an ascension.[5]

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[1] Vol. I, p. 17 of this bulletin.

[2] Vol. I, p. 18 of this bulletin.

[3] Vol. I, p. 100 of this bulletin.

[4] Vol. II, p. 312 of this bulletin.

[5] Vol. III, p. 40 of this bulletin.

Wind directions at the surface and at the highest point reached in an ascension are respectively indicated by the lower and upper of the two red arrows at the top of the chart. The arrows point in the direction of the air's horizontal motion. Directions are given to 16 points and are mapped according to the usual convention. In the isothermal charts beginning with this period, the wind velocity in meters per second is shown at the right of each arrow.[1]

THE DIURNAL RANGE OF TEMPERATURE.

For the purpose of studying the diurnal changes in the free air temperatures, series of 3,000-meter ascensions have been undertaken. These ascensions succeed each other closely throughout the 24-hour period, each ascension being of about 3 hours duration. Thus far, clear nights have been chosen for these series of ascensions. Cloudiness would introduce temperature effects of which it would be hard at first to take account. The effect of air movement is also a difficult one to account for, especially in a mountainous district, but it can not be eliminated at the time the data is acquired.

The first of these series of observations was made on August 16 and 17, 1911. The extremes of the barometric range were slightly less than 1.5 millimeters apart, and the barometer at 11 a. m. on the 17th was 1 millimeter higher than at 7 a. m. on the 16th. Some clouds were present during most of this series. Their kind and description are noted in connection with the tabulated data. Cumulous clouds passed close to the kites in the third and fourth ascensions of the series. The altitude of their bases was about 2.9 kilometers above sea level.

Figure 7 shows the free-air isotherms, one degree centigrade apart, from 7 a. m. of August 16 to 11 a. m. of August 17. Figure 8 shows the temperatures observed at the earth's surface and at the half kilometer levels up to 3 kilometers above sea level. . The inversion of temperature observed in the first and second ascensions (see fig. 7) occurred in a region of comparatively low relative humidity.

The second series of ascensions was made on September 12 and 13, 1911. During this series the barometer was rising slowly or not at all until about 5 p. m. of the 12th, more rapidly and rather uniformly until 1 p. m. of the 13th. The sky was nearly clear when the series was begun, but became clouded later. The amount and kind of clouds, also the altitudes of those reached by the kites, may be found with the tabulated data. The actual air pressures are also given in the tables. For this series, figures 9 and 10 show the trend of the isotherms at all levels reached and of the temperatures at the half-kilometer levels respectively. In figures 8, 10, and 11, the values of the ordinates for the curves representing temperatures at the earth's surface, the 1.5, 2.5, and 3.5 kilometer levels are indicated at the left; those for the 1, 2, and 3 kilometer levels at the right.

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[1] Vol. IV, p. 65 of this bulletin.

In both of these series of ascensions there is a change in temperature at all levels reached from the first day to the second. The approximate amount of this change is shown in figures 8 and 10 by the straight dashed lines. The mean temperatures for the day at the different levels are shown by the straight solid lines. Consider the hours 7.30 a. m. to 7.30 a. m., eliminate the temperature change from day to day, take means of the corrected hourly temperatures of both series at each level, and smooth the means for any hour by the consideration of the temperatures of the hour just before and the hour just after it. The curves in figure 11 will be the result. Table I also shows the steps in this operation. From the curves and from the table it will be seen that the taking of a mean of the results of the two series is legitimate. With the exception of the inversion observed early in the first series, the diurnal ranges of temperature shown in both series are much alike. The inversion probably causes the minimum temperature for the day to occur a trifle later at the 1.5, 2, and 2.5 kilometer levels than it would normally.

TABLE I.

Hour.	526 meters (surface).					1,000 meters.				
	Corrected temperatures.			Smoothed means.	Departure from daily mean.	Corrected temperatures.			Smoothed means.	Departure from daily mean.
	First series.	Second series.	Means.			First series.	Second series.	Means.		
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
8 a. m.	21.2	14.3	17.8	17.9	−2.9	19.2	12.0	15.6	15.5	−2.0
9 a. m.	22.2	14.9	18.6	19.0	−1.8	18.8	12.4	15.6	15.8	−1.7
10 a. m.	24.3	16.9	20.6	20.0	−0.2	19.6	12.8	16.2	16.3	−1.2
11 a. m.	25.9	19.1	22.5	22.2	+1.4	20.7	13.2	17.0	16.9	−0.6
12 m.	26.9	20.3	23.6	23.5	+2.7	21.6	13.5	17.6	17.8	+0.3
1 p. m.	27.9	20.8	24.4	24.3	+3.5	23.4	14.2	18.8	18.7	+1.2
2 p. m.	28.8	20.7	24.8	24.6	+3.8	24.1	15.0	19.6	19.4	+1.9
3 p. m.	28.8	20.6	24.7	24.7	+3.9	24.3	15.5	19.9	19.8	+2.3
4 p. m.	28.7	20.6	24.6	24.5	+3.7	23.9	15.6	19.8	19.7	+2.2
5 p. m.	28.1	20.5	24.3	24.3	+3.5	22.9	15.9	19.4	19.7	+2.2
6 p. m.	26.9	19.6	23.2	23.3	+2.5	22.3	17.6	20.0	19.7	+2.2
7 p. m.	26.2	18.7	22.4	22.5	+1.7	22.2	17.4	19.8	19.7	+2.2
8 p. m.	25.6	18.5	22.0	21.9	+1.1	22.9	15.6	19.2	19.1	+1.6
9 p. m.	24.9	18.0	21.4	21.3	+0.5	22.1	14.5	18.3	18.5	+1.0
10 p. m.	23.7	17.3	20.5	20.7	−0.1	21.8	14.1	18.0	17.9	+0.4
11 p. m.	23.5	16.8	20.2	20.1	−0.7	21.7	12.9	17.3	17.4	−0.1
12 midnight	23.4	15.6	19.5	19.7	−1.1	21.7	12.3	17.0	17.1	−0.4
1 a. m.	23.3	15.5	19.4	19.3	−1.5	21.6	12.3	17.0	16.7	−0.8
2 a. m.	22.7	15.4	19.0	18.9	−1.9	20.6	11.3	16.0	16.3	−1.2
3 a. m.	22.0	14.4	18.2	18.3	−2.5	20.1	11.4	15.8	15.9	−1.6
4 a. m.	21.3	14.2	17.8	17.7	−3.1	20.0	12.0	16.0	15.9	−1.6
5 a. m.	20.7	13.7	17.2	17.3	−3.5	19.9	11.9	15.9	15.8	−1.7
6 a. m.	20.0	13.5	16.8	17.0	−3.8	19.3	11.6	15.4	15.5	−2.0
7 a. m.	20.5	14.0	17.2	17.3	−3.5	18.7	11.6	15.2	15.4	−2.1
Means	24.5	17.2	20.8	....	......	21.4	13.6	17.5	....	......

TABLE I—Continued.

Hour.	1,500 meters.					2,000 meters.				
	Corrected temperatures.			Smoothed means.	Departure from daily mean.	Corrected temperatures.			Smoothed means.	Departure from daily mean.
	First series.	Second series.	Means.			First series.	Second series.	Means.		
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
8 a. m	15.8	11.5	13.6	13.3	−0.8	14.3	9.7	12.0	11.8	+0.4
9 a. m	15.2	10.8	13.0	13.3	−0.8	15.8	7.2	11.5	11.5	+0.1
10 a. m	16.4	10.4	13.4	13.2	−0.9	15.6	6.2	10.9	10.9	−0.5
11 a. m	16.1	10.3	13.2	13.1	−1.0	14.4	6.1	10.2	10.1	−1.3
12 m	14.8	10.6	12.7	13.4	−0.7	11.5	6.7	9.1	9.6	−1.8
1 p. m	17.6	11.0	14.3	14.0	−0.1	11.4	7.4	9.4	9.6	−1.8
2 p. m	18.4	11.8	15.1	14.9	+0.8	12.6	7.9	10.2	10.3	−1.1
3 p. m	18.4	12.5	15.4	15.1	+1.0	14.0	8.6	11.3	10.8	−0.6
4 p. m	18.1	11.7	14.9	15.0	+0.9	14.1	7.5	10.8	10.9	−0.5
5 p. m	17.7	11.6	14.6	14.9	+0.8	13.4	7.8	10.6	10.7	−0.7
6 p. m	17.7	12.9	15.3	15.1	+1.0	12.7	9.0	10.8	10.8	−0.6
7 p. m	17.9	12.7	15.3	15.0	+0.9	12.7	9.5	11.1	11.0	−0.4
8 p. m	18.0	10.8	14.4	14.8	+0.7	13.0	9.4	11.2	11.3	−0.1
9 p. m	17.5	11.9	14.7	14.4	+0.3	13.2	9.8	11.5	11.4	0.0
10 p. m	16.7	11.4	14.0	13.7	−0.4	13.4	9.9	11.6	11.4	0.0
11 p. m	16.2	8.8	12.5	13.3	−0.8	13.5	8.4	11.0	11.4	0.0
12 midnight	16.5	10.5	13.5	13.5	−0.6	13.7	9.5	11.6	11.9	+0.5
1 a. m	17.0	12.3	14.6	14.3	+0.2	14.2	11.9	13.0	12.6	+1.2
2 a. m	17.4	12.2	14.8	14.6	+0.5	14.9	11.7	13.3	13.2	+1.8
3 a. m	17.2	11.4	14.3	14.4	+0.3	15.4	10.9	13.2	13.2	+1.8
4 a. m	16.7	11.7	14.2	14.0	−0.1	15.3	10.6	13.0	12.9	+1.5
5 a. m	16.2	11.0	13.6	13.6	−0.5	14.9	10.3	12.6	12.6	+1.2
6 a. m	15.9	10.3	13.1	13.3	−0.8	14.2	10.0	12.1	12.2	+0.8
7 a. m	15.5	11.1	13.3	13.3	−0.8	14.1	10.0	12.0	12.0	+0.6
Means	16.9	11.3	14.1			13.8	9.0	11.4		

Hour.	2,500 meters.					3,000 meters.				
	Corrected temperatures.			Smoothed means.	Departure from daily mean.	Corrected temperatures.			Smoothed means.	Departure from daily mean.
	First series.	Second series.	Means.			First series.	Second series.	Means.		
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
8 a. m	11.6	7.4	9.5	9.0	+0.6	8.2	4.5	6.4	5.8	+0.6
9 a. m	12.2	5.4	8.8	8.8	+0.4	7.7	3.5	5.6	5.7	+0.5
10 a. m	12.2	4.2	8.2	8.2	−0.2	7.4	2.7	5.0	5.1	−0.1
11 a. m	11.6	3.5	7.6	7.5	−0.9	7.1	2.2	4.6	4.6	−0.6
12 m	10.2	3.3	6.8	6.8	−1.6	6.6	1.7	4.2	4.1	−1.1
1 p. m	8.1	3.7	5.9	6.2	−2.2	5.4	1.4	3.4	3.6	−1.6
2 p. m	7.8	3.8	5.8	6.2	−2.2	5.0	1.4	3.2	3.7	−1.5
3 p. m	10.1	3.9	7.0	6.7	−1.7	7.2	1.8	4.5	4.2	−1.0
4 p. m	10.5	4.4	7.4	7.4	−1.0	7.2	2.4	4.8	4.8	−0.4
5 p. m	10.5	5.3	7.9	7.7	−0.7	6.9	3.0	5.0	4.8	−0.4
6 p. m	9.3	6.2	7.8	7.8	−0.6	5.7	3.4	4.6	4.6	−0.6
7 p. m	8.7	6.6	7.6	7.7	−0.7	4.6	3.6	4.1	4.2	−1.0
8 p. m	8.8	6.5	7.6	7.7	−0.7	4.6	3.4	4.0	4.2	−1.0
9 p. m	9.0	7.0	8.0	8.0	−0.4	4.7	4.0	4.4	4.4	−0.8
10 p. m	9.3	7.7	8.5	8.2	−0.2	5.0	4.6	4.8	4.7	−0.5
11 p. m	9.8	6.4	8.1	8.5	+0.1	5.6	4.0	4.8	5.1	−0.1
12 midnight	10.5	7.0	8.8	9.0	+0.6	6.7	4.7	5.7	5.7	+0.5
1 a. m	11.3	9.0	10.2	9.8	+1.4	7.2	6.0	6.6	6.4	+1.2
2 a. m	11.5	9.4	10.4	10.2	+1.8	7.2	6.3	6.8	6.7	+1.5
3 a. m	11.8	8.4	10.1	10.3	+1.9	7.5	6.1	6.8	7.0	+1.8
4 a. m	12.5	8.5	10.5	10.2	+1.8	8.5	6.1	7.3	7.1	+1.9
5 a. m	11.7	8.2	10.0	9.8	+1.4	8.4	6.0	7.2	7.0	+1.8
6 a. m	10.5	7.6	9.0	9.2	+0.8	7.5	5.3	6.4	6.4	+1.2
7 a. m	10.2	7.1	8.6	9.0	+0.6	6.6	4.4	5.5	6.1	+0.9
Means	10.4	6.3	8.4			6.6	3.8	5.2		

The minimum shown at 6 a. m. in the curve of surface temperatures appears later at higher altitudes until it reaches a position almost directly above the surface maximum. The principal surface maximum becomes a secondary one above the 1.5-kilometer level and occurs a little later at the higher altitudes. A slight decrease in the slope of the surface curve after midnight gradually develops with altitude into the principal maximum of the day in the curves above the 1.5-kilometer level. The principal temperature maximum for the day at the 3-kilometer level is more than 12 hours later than the principal maximum at the surface. For the levels shown, the departures from the mean daily temperature are least at 1.5 kilometers. When all levels are considered, the actual temperatures at 10 to 11 a. m. and at 10 to 11 p. m. are, so far as the diurnal range shown by these series is concerned, nearest to the mean temperature for the day. It is to be noted that the retardation with increasing altitude of the minimum and maximum temperatures for the day occurs in the three lower levels and that, above the 2-kilometer level, the principal minimum and maximum of daily temperature at any level can hardly be considered as the surface minimum and maximum retarded. The transition from the temperature distribution peculiar to the lower levels to that peculiar to the upper levels explored in these series seems to occur at or not far above the 1.5-kilometer level. Up to the 1.5-kilometer level these data are in general agreement with the work of Clayton, Wundt, and Gold on the diurnal range of temperature at different levels. Above the 1.5-kilometer level the diurnal range shown by these data is not imperceptible, as thought by Clayton, nor are the positions of the maxima and minima of temperature for the day those found by Gold.

When compared with the curves of figures 12 to 14, the surface curve of figure 11 shows a range of temperature somewhat greater than that shown by the Mount Weather curves for the months in which the series of ascensions occur, about equal to that shown by the Trapp curves, and somewhat less than that shown by the Audley curves. All of these curves have essentially the same characteristics. The curves in figures 12 to 14 represent average conditions for the months considered, while that in figure 11 probably represents comparatively clear-weather conditions. Table II shows the cloudiness for July, August, and September, 1911.

TABLE II.

Month.	Number of days.			Mean cloudiness in tenths.
	Cloudy.	Partly cloudy.	Clear.	
July	3	17	11	5.0
August	12	11	8	6.0
September	8	15	7	5.7

Other series of ascensions similar to the above are being obtained as conditions permit. Final conclusions as to the cause and amount of the departure of the hourly temperatures from the mean for the day at the different levels can not be drawn from the two series. As to the cause of the phenomena observed, one may remark tentatively that the 2 to 3 p. m. maximum seems to be the principal one at all levels reached by the most local convection currents, i. e., those currents, owing to the heating of the earth's surface, which start shortly after sunrise, reach their maximum height shortly after the sun has passed the meridian, and subside gradually with the cooling of the earth's surface relative to the air near it. Such currents were observed under especially favorable conditions on May 19, 1910, and have been described in Volume III, page 169 of this bulletin. The height to which these currents extend varies with weather conditions and with seasons, latitude, topography, and the nature of the earth's surface. For the days under consideration above, it seems to have been between 1.5 and 2 kilometers. These currents carry moisture and dust from the earth's surface into the stratum of air affected by them, rendering it less diathermanous and consequently comparatively warm. The formation of dew or frost and the settling of the dust gradually clear the lower air, rendering it more and more diathermanous until the convection currents of the next day start. It follows that, for the stratum affected by these convection currents, the air most diathermanous, and consequently coolest, will be found just before the convection currents have disturbed it. Since these currents increase in height until 2 or 3 p. m., the greatest negative departure from the mean temperature of the day (all changes in temperature other than the diurnal having been eliminated) may be expected to incline forward with altitude in the stratum of air considered.

Above this stratum the greatest negative departure from the mean temperature of the day may be expected to occur almost directly over the greatest positive departure within the stratum, i. e., above the least diathermanous air of the lower stratum. A comparatively large percentage of the radiation from the earth's surface is absorbed in the lower stratum at this time of day, and therefore a comparatively small percentage of this radiation is available for heating the stratum just above it. Above the stratum affected by the convection currents in question the greatest positive departure from the mean temperature for the day may be expected almost directly over the greatest negative departure within the stratum, because a comparatively small percentage of the radiation from the earth's surface is absorbed in the lower stratum at this time of day, and therefore a comparatively large percentage is available for heating the stratum just above it.

From consideration of the earth's potential as a radiator and the diathermance of the lower stratum in question, the minimum and maximum of air temperature for the day in the stratum next above would be expected just before the surface maximum and minimum, respectively. The same considerations would lead to the expectation of a secondary minimum and maximum in the stratum just above, following the maximum and minimum, respectively, of the lower stratum. The additional consideration of the heat radiation from the air itself may account for their absence or lack of definition in the curves of figure 11.

The altitudes reached in the ascensions of the two series under consideration are not great enough to show the altitude at which the diurnal range of temperature becomes small or disappears. If the above discussion of the cause of the diurnal range found at the levels reached is correct, the departures of the hourly temperatures from the mean for the day should decrease rapidly in the upper limit of the lower moist stratum of the atmosphere, i. e., at 3 to 5 kilometers above sea level, depending on the season—at higher levels in the summer than in the winter months. Whether or not these departures will be perceptible above this level should depend somewhat on the percentage of radiation from the earth's surface that gets through the lower moist stratum, somewhat on the absorption of direct and reflected solar radiation at the level considered, and on the radiation from the lower air strata to those immediately above. It will also depend on the presence in the stratum in question of materials which absorb heat radiation, chiefly water vapor and carbon dioxide, the latter, whatever the free air temperature, apparently always in close combination with water. Hourly temperature data are not yet available at the higher levels. In considering the excellent series of free balloon ascensions made by the University of Manchester on June 2 and 3, 1909, and on March 18 and 19, 1910, it is found that the diurnal range of temperature is comparatively small even at the earth's surface—probably not much in excess of the instrumental error—and that it is masked by the temperature effects which apparently accompany the peculiar pressure distribution at the times of observation.

The departures of the hourly temperatures from the mean for the day are shown in Table I. These departures may be about right in amount for the months in which the observations were made, but their quantitative determination will require more observations.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 1:	*mm.*	*° C.*	%		*m. p. s.*	*m.*	*mm.*	*° C.*	%		*m. p. s.*
1.30 p. m...	719.4	24.2	55	nw.	4.9	526	719.4	24.2	55	nw.	4.9
1.39 p. m...	719.4	24.6	58	nw.	4.9	1,411	649.3	15.0	......	nnw.	....
1.57 p. m...	719.3	24.8	58	nnw.	6.3	1,009	680.4	19.2	......	nnw.	....
2.06 p. m...	719.3	24.8	55	nw.	3.6	704	704.8	21.2	......	nnw.	....
2.14 p. m...	719.3	25.3	54	nw.	3.6	526	719.3	25.3	54	nw.	3.6
July 2:											
6.18 a. m....	718.0	21.5	66	wnw.	7.2	526	718.0	21.5	66	wnw.	7 2
6.28 a. m....	718 0	21.7	67	wnw.	7.2	865	690.7	23.4	60	nnw.	12.6
6.36 a. m....	718.0	22.0	65	wnw.	7.2	1,229	662.5	20.6	68	n.	10.2
7.13 a. m....	718.0	23.0	65	wnw.	7.2	1,768	622.4	16.0	78	nne.	10.8
7.41 a. m....	718.1	23.5	67	wnw.	7.2	2,183	592.8	12.7	74	nne.	10.4
8.07 a. m....	718.1	23.8	67	wnw.	7.6	2,725	555.8	9.6	48	nne.	13.2
8.43 a. m....	718.2	23.8	69	wnw.	7.6	3,787	488.2	− 0.3	59	nne.	15.2
9.20 a. m....	718.2	24.4	70	wnw.	7.2	3,970	477.1	− 2.1	61	nne.	14.9
9.54 a. m....	718.2	24.8	71	wnw.	5.8	2,978	539.6	7.8	43	nne.	8.1
10.14 a. m....	718.2	25.1	69	wnw.	5.8	4,313	457.2	− 4.4	65	nne.	27.0
10.25 a. m....	718.2	25.8	69	wnw.	6.3	4,465	449.0	− 5.8	66	nne.	24.5
10.58 a. m....	718.2	27.0	66	wnw.	6.3	4,113	469.6	− 2.7	69	nne.	24.5
11.06 a. m....	718.2	27.2	66	wnw.	5.8	3,998	476.3	− 1.9	67	nne.	18.0
11.27 a. m....	718.1	27.7	65	wnw.	5.8	3,721	493.2	1.3	55	nne.	15.2
11.52 a. m....	718.0	28.8	61	wnw.	7.2	3,182	527.2	5.8	53	nne.	12.3
12.07 p. m...	718.0	29.2	59	wnw.	5.8	2,686	559.5	11.1	46	nne.	10.8
12.20 p. m...	717.9	29.2	60	wnw.	6.7	2,281	587.2	15.1	39	nne.	8.9
12.39 p. m...	717.9	29.4	62	wnw.	6.3	1,878	615.6	19.1	38	n.	10.2
12.51 p. m...	717.8	29.9	60	wnw.	5.4	1,382	651.6	23.4	33	nnw.	15.4
12.58 p. m...	717.8	20.8	59	wnw.	6.3	829	693.8	25.8	53	nw.	8.7
1.01 p. m...	717.8	29.6	61	wnw.	6.3	526	717.8	29.6	61	wnw.	6.3
July 3:											
6.34 a. m....	717.4	24.4	70	wnw.	5.8	526	717.4	24.4	70	wnw.	5.8
6.42 a. m....	717.4	24.5	69	wnw.	5.4	941	684.5	25.8	55	nne.	13.6
6.55 a. m....	717.4	24.8	69	wnw.	5.4	1,361	652.4	20.9	65	nne.	10.8
7.09 a. m....	717.4	25.0	69	wnw.	5.4	1,695	627.8	18.4	72	nne.	11.2
7.25 a. m....	717.4	25.0	68	wnw.	5.8	2,082	599.9	13.9	82	nne.	14.0
7.47 a. m....	717.4	25.8	67	wnw.	5.8	2,295	584.9	11.3	89	nne.	10.4
9.18 a. m....	717.4	26.0	70	wnw.	5.4	3,205	523.8	2.9	66	nne.	16.7
9.41 a. m....	717.4	27.1	65	wnw.	5.4	2,378	579.2	10.0	87	nne.	10.6
9.55 a. m....	717.4	27.5	65	wnw.	5.4	2,153	595.2	12.6	74	nne.	10.6
10.14 a. m....	717.4	27.7	65	wnw.	5.4	1,709	626.9	18.0	55	nne.	10.3
10.28 a. m....	717.4	28.6	66	wnw.	5.4	1,406	649.4	21.3	54	nne.	12.8
10.37 a. m....	717.4	26.1	65	nw.	5.4	983	681.4	25.4	42	nne.	11.9
10.48 a. m....	717.4	28.4	64	nw.	4.9	526	717.4	28.4	64	nw.	4.9

July 1.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m. There were 7/10 Ci. from the northwest and a few Cu. from the north-northwest. Pressure was high over West Virginia and low over Manitoba.

July 2.—Ten kites were used; lifting surface, 63.5 sq. m. Wire out, 9,700 m.; at maximum altitude, 8,700 m.

The sky was 6/10 to 9/10 covered with Ci.-St. and A.-Cu., both from the north-northeast. There was a solar halo.

High pressure, central over West Virginia, covered the country from the Lake region to the Gulf of Mexico. Pressure was low over the St. Lawrence Valley.

July 3.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 5,900 m.; at maximum altitude, 4,900 m.

There were 2/10 to 6/10 Ci. from the north and after 7.47 a. m., from a few to 5/10 St.-Cu. from the north:

Pressure was low over the Gulf of St. Lawrence and high from Ohio to Florida.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 4:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
10.06 a. m....	718.3	29.4	61	se.	2.2	526	718.3	29.4	61	se.	2.2
10.19 a. m....	718.4	29.7	62	se.	2.2	2,224	591.9	18.0	......	ne.	....
10.39 a. m....	718.4	31.0	58	e.	0.9	1,844	618.7	19.9	......	e.	....
10.49 a. m....	718.5	31.3	63	nw.	0.9	1,569	638.8	23.0	......	se.	....
10.56 a. m....	718.5	31.0	60	se.	0.9	952	685.1	26.2	......	sse.	....
11.05 a. m....	718.5	29.9	61	se.	2.7	526	718.5	29.9	61	se.	2.7
July 5:											
2.21 p. m....	720.2	30.3	55	s.	5.1	526	720.2	30.3	55	s.	5.1
2.26 p. m....	720.2	30.4	55	s.	5.6	715	705.2	27.6	50	s.	8.4
2.39 p. m....	720.2	30.5	52	s.	4.5	950	686.7	24.1	57	s.	8.0
3.50 p. m....	719.7	30.3	50	se.	5.8	1,336	656.5	20.1	58	s.	8.4
4.39 p. m....	719.6	29.8	49	se.	5.6	1,547	640.7	19.6	54	s.	7.4
4.54 p. m....	719.5	29.6	48	sse.	6.4	1,097	674.6	22.3	53	s.	11.7
5.03 p. m....	719.5	29.5	49	s.	5.6	878	691.6	24.7	52	s.	9.2
5.13 p. m....	719.5	29.4	49	se.	6.5	526	719.5	29.4	49	se.	6.5
July 6:											
6.41 a. m....	720.1	23.3	68	w.	6.7	526	720.1	23.3	68	w.	6.7
6.55 a. m....	720.1	23.0	70	w.	6.7	821	696.3	24.0	53	wnw.	8.1
7.30 a. m....	720.1	23.9	68	w.	7.2	1,185	668.0	21.3	60	nw.	7.0
8.58 a. m....	720.1	26.4	54	w.	3.1	1,592	637.3	17.2	63	nnw.	5.0
9.09 a. m....	720.1	26.7	57	w.	3.1	1,302	659.0	19.7	65	nw.	12.2
9.23 a. m....	720.1	27.2	52	w.	2.7	1,132	672.0	21.3	63	nw.	12.2
9.30 a. m....	720.1	27.2	55	w.	2.7	526	720.1	27.2	55	w.	2.7
July 7:											
7.48 a. m....	718.9	20.6	91	nw.	6.7	526	718.9	20.6	91	nw.	6.7
8.01 a. m....	719.0	21.5	79	ne.	6.8	729	702.6	26.5	53	ene.	8.3
8.03 a. m....	719.0	21.6	79	ne.	6.7	1,342	654.9	19.3	68	ene.	12.7
8.15 a. m....	719.1	21.8	81	ne.	7.8	1,185	666.9	23.2	55	ene.	6.1
8.26 a. m....	719.2	20.5	91	ese.	7.6	910	688.2	22.5	97	ese.	....
8.34 a. m....	719.2	20.3	95	e.	10.1	526	719.2	20.3	95	e.	10.1

July 4.—One captive balloon was used; capacity 22.4 cu. m. Wire out, 2,200 m.

Ci.-Cu. from the northeast and A.-Cu. from the east-northeast diminished from 6/10 to 3/10. Solar halo, 10.30 to 10.40 a. m.

Pressure was low over the lower St. Lawrence, and was high north of Lake Huron and off the middle Atlantic coast.

July 5.—Five kites were used; lifting surface, 33.5 sq. m. Wire out 3,000 m., at maximum altitude.

There were 2/10 to 1/10 Cu., whose direction varied from south to south-southwest. There was light haze.

Pressure was high over the lower St. Lawrence Valley and low to the east and west thereof, with a secondary low central over northwestern Iowa. Pressure was high off the south Atlantic coast.

July 6.—Five kites were used; lifting surface, 33.5 sq. m. Wire out, 3,100 m.; at maximum altitude, 2,400 m.

There were a few A.-Cu. from the east after 8.06 a. m.

Pressure was low over the Gulf of St. Lawrence and high over South Dakota and off the south Atlantic coast.

July 7.—Two kites were used; lifting surface, 13.1 sq. m. Wire out 1,200 m.; at maximum altitude, 850 m.

There were 10/10 St., direction varying between northeast and east-southeast. Fog drifted across the mountain at intervals. Rain fell after 8.08 a. m.

Pressure was high off the South Atlantic coast and over the Lake region and low over southern Newfoundland, with a secondary depression over the middle Atlantic coast.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 8:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.09 a. m....	720.5	19.6	94	e.	6.7	526	720.5	19.6	94	e.	6.7
6.31 a. m....	720.7	20.0	91	e.	6.3	822	696.5	20.8	77	ese.	7.1
6.48 a. m....	720.8	19.6	95	e.	5.8	850	694.4	18.5	90	ese.	6.8
6.58 a. m....	721.0	19.5	95	e.	4.5	1,094	675.1	19.0	78	ese.	6.7
7.06 a. m....	721.0	19.7	96	e.	3.6	526	721.0	19.7	96	e.	3.6
July 9:											
9.21 a. m....	722.1	25.6	82	sse.	3.4	526	722.1	25.6	82	sse.	3.4
9.30 a. m....	722.1	25.5	84	se.	2.9	1,801	623.3	17.1	......	ssw.	....
9.40 a. m....	722.1	25.7	85	se.	3.7	1,018	682.7	20.3	......	ssw.	....
9.50 a. m....	722.1	25.4	80	se.	3.2	831	697.4	22.4	......	ssw.	....
9.56 a. m....	722.1	25.2	79	se.	3.2	526	722.1	25.2	79	se.	3.2
July 10:											
6.23 a. m....	721.7	23.8	74	wnw.	8.9	526	721.7	23.8	74	wnw.	8.9
6.35 a. m....	721.8	23.8	74	wnw.	8.0	873	693.8	22.9	69	nw.	20.3
6.48 a. m....	721.8	23.8	75	wnw.	8.9	1,224	666.5	21.0	72	nw.	10.4
8.23 a. m....	721.6	25.0	73	wnw.	8.5	1,551	641.8	18.8	62	nw.	4.8
9.15 a. m....	721.4	26.2	71	wnw.	8.5	1,197	668.5	21.7	61	nw.	7.1
9.41 a. m....	721.4	26.6	71	wnw.	6.7	898	691.7	25.5	50	nw.	4.3
9.59 a. m....	721.4	27.1	68	wnw.	6.7	526	721.4	27.1	68	wnw.	6.7
July 11:											
6.28 a. m....	718.3	22.6	82	wnw.	8.5	526	718.3	22.6	82	wnw.	8.5
6.35 a. m....	718.3	22.6	82	wnw.	8.9	845	692.5	22.5	70	wnw.	15.3
6.48 a. m....	718.3	22.6	84	wnw.	8.5	1,236	662.2	20.6	65	nw.	14.1
7.12 a. m....	718.3	23.0	82	wnw.	8.5	1,751	623.8	17.6	61	nw.	7.2
8.30 a. m....	718.3	24.4	76	wnw.	8.0	2,099	598.9	13.1	72	wnw.	8.0
8.51 a. m....	718.3	24.3	82	wnw.	7.6	2,840	547.9	6.0	93	wnw.	12.1
9.16 a. m....	718.3	25.0	77	wnw.	7.6	2,081	599.9	14.5	61	wnw.	7.1
9.27 a. m....	718.3	25.4	74	wnw.	7.2	1,708	626.8	17.6	59	wnw.	7.6
9.42 a. m....	718.3	25.6	74	wnw.	7.6	1,352	653.3	18.9	65	wnw.	14.0
9.54 a. m....	718.3	25.9	72	wnw.	6.3	977	682.3	21.4	79	nw.	14.0
10.01 a. m....	718.3	26.0	68	wnw.	6.7	526	718.3	26.0	68	wnw.	6.7

July 8.—Four kites were used; lifting surface, 25.7 sq. m. Wire out, 1,800 m.; at maximum altitude, 1,000 m.

There were 6/10 A.-Cu. from the southwest at the beginning of the flight; by 6.45 a. m. they were obscured by 10/10 St. from the east-southeast, at an altitude of 600 m.

Pressure was high off the North Atlantic States and low over North Dakota.

July 9.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m. There were 4/10 to 2/10 St. and St.-Cu. from the southwest.

A few Ci.-St., direction indeterminable, disappeared during the flight.

Pressure was high over the middle and south Atlantic coast and low over the lower St. Lawrence Valley and over Manitoba.

July 10.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 5,700 m.; at maximum altitude, 4,800 m.

About 8/10 A.-Cu. and St.-Cu. from the west prevailed until 7.30 a. m., gradually dissipating thereafter. About 6/10 Ci.-St. from the west, with solar halo, were visible after 8.45 a. m.

Pressure was high over the southeastern States and low over Manitoba.

July 11.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 6,500 m.; at maximum altitude, 4,700 m.

There were a few to 5/10 A.-Cu. from the west-southwest.

Pressure was low north of Lake Superior and high over the South Atlantic and Gulf coasts.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 12:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
3.38 p. m...	716.3	29.5	50	wsw.	3.1	526	716.3	29.5	50	wsw.	3.1
3.47 p. m...	716.3	29.6	50	sw.	2.4	2,104	597.7	16.2	......	nnw.	....
4.00 p. m...	716.2	29.4	50	w.	2.9	1,482	692.4	19.6	......	nw.	....
4.14 p. m...	716.2	29.7	49	w.	2.5	905	686.3	24.9	......	wnw.	....
4.24 p. m...	716.2	29.5	48	wnw.	2.4	526	716.2	29.5	48	wnw.	2.4
July 13:											
2.21 p. m...	718.7	26.4	46	nnw.	1.8	526	718.7	26.4	46	nnw.	1.8
2.33 p. m...	718.7	27.6	46	wsw.	1.8	1,747	624.5	16.6	......	wnw.	....
2.48 p. m...	718.7	26.4	46	wnw.	3.6	1,476	644.6	16.9	......	wnw.	....
2.58 p. m...	718.7	26.6	49	n.	3.1	1,042	677.7	21.8	......	n.	....
3.04 p. m...	718.7	26.6	49	nnw.	3.1	526	718.7	26.6	49	nnw.	3.1
July 14:											
1.31 p. m...	719.4	22.6	76	ese.	1.8	526	719.4	22.6	76	ese.	1.8
1.44 p. m...	719.4	24.0	71	ese.	2.2	2,181	592.9	11.3	......	nw.	....
1.58 p. m...	719.4	24.2	71	e.	1.8	1,359	653.2	17.4	......	nw.	....
2.01 p. m...	719.4	24.2	71	ne.	1.8	1,157	668.9	17.0	......	nw.	....
2.05 p. m...	719.4	24.3	71	e.	1.8	986	682.3	18.1	......	nw.	....
2.17 p. m...	719.3	23.7	71	calm.	0.0	526	719.3	23.7	71	calm.	0.0
July 15:											
11.23 a. m....	720.7	24.7	63	se.	2.8	526	720.7	24.7	63	se.	2.8
11.57 a. m....	720.5	26.1	46	calm.	0	2,398	578.9	8.7	......	calm.	....
12.05 p. m...	720.5	25.8	48	calm.	0	1,538	641.2	15.7	......	calm.	....
12.17 p. m...	720.5	25.9	51	wsw.	1.2	1,013	681.5	20.6	......	calm.	....
12.23 p. m....	720.5	25.4	46	ssw.	1.2	526	720.5	25.4	46	ssw.	1.2

July 12.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m. There were 1/10 to a few Ci.-St. from the west-northwest and a few Cu. from the northwest.

Pressure was low over the lower St. Lawrence Valley and high over Alberta and Alabama.

July 13.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m. There were a few to 4/10 Ci.-St. from the west.

Pressure was low over the Gulf of St. Lawrence and high over Montana.

July 14.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m. There were 1/10 to 2/10 A.-Cu. from the southwest and 2/10 to 3/10 Cu. from the northeast.

Pressure was moderately high over the Missouri Valley and off the South Atlantic coast and relatively low over Nova Scotia.

July 15.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m. There were 1/10 Ci.-Cu. and 4/10 Ci.-St. from the southwest at the beginning and 6/10 Ci. from the west at the end of the flight; a few to 3/10 Cu. at an altitude of 2,300 meters.

Pressure was low north of Lake Superior and high off the Atlantic coast.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 16:											
Balloon ascension—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.25 a. m....	718.9	24.8	59	se.	2.2	526	718.9	24.8	59	se.	2.2
8.47 a. m....	718.9	25.0	64	se.	2.2	2,018	604.9	13.3	......	calm.	....
8.56 a. m....	718.9	24.7	61	se.	2.7	1,672	630.1	17.0	......	se.	....
9.05 a. m....	718.9	24.6	67	ese.	3.1	823	695.0	23.1	......	sse.	....
9.16 a. m....	718.9	23.8	67	ese.	3.1	526	718.9	23.8	67	ese.	3.1
Kite flight—											
2.39 p. m....	716.8	27.2	48	s.	4.0	526	716.8	27.2	48	s.	4.0
3.25 p. m....	716.6	27.9	43	s.	4.0	921	685.3	22.9	42	s.	9.0
4.13 p. m....	716.3	27.8	44	s.	6.7	1,282	657.1	19.1	54	s.	9.0
4.32 p. m....	716.2	27.3	51	s.	7.2	1,609	632.4	14.0	84	s.	10.3
4.50 p. m....	716.1	27.0	54	sse.	8.0	2,254	585.5	8.2	100	s.	9.0
5.11 p. m....	715.9	26.5	60	sse.	6.3	2,477	569.7	6.9	69	s.	10.5
5.17 p. m....	715.9	26.4	59	sse.	6.3	3,093	528.0	1.5	85	s.	13.1
5.28 p. m....	715.9	26.2	57	se.	7.6	2,510	566.9	7.0	60	s.	11.0
5.38 p. m....	715.8	26.3	58	se.	8.5	2,084	596.8	9.5	100	s.	15.6
5.46 p. m....	715.8	26.4	59	se.	6.7	1,560	635.4	14.2	84	s.	14.4
5.57 p. m....	715.7	25.9	62	se.	8.5	1,245	659.1	17.4	82	sse.	14.4
6.08 p. m....	715.7	25.4	64	se.	8.9	908	685.3	21.5	70	sse.	13.0
6.16 p. m....	715.7	25.2	66	se.	8.5	526	715.7	25.2	66	se.	8.5
July 17:											
10.19 a. m....	712.5	18.7	96	wnw.	5.4	526	712.5	18.7	96	wnw.	5.4
10.29 a. m....	712.5	18.8	96	wnw.	5.4	888	683.2	16.7	80	wnw.	11.2
11.11 a. m....	712.4	20.0	93	wnw.	6.3	1,455	639.1	14.2	72	wnw.	9.5
12.16 p. m....	712.1	21.5	80	wnw.	7.6	1,648	624.5	12.5	67	wnw.	7.1
12.38 p. m....	712.1	22.4	74	wnw.	6.7	2,030	596.6	10.0	73	wnw.	8.5
12.49 p. m....	712.0	22.8	73	wnw.	6.7	2,565	559.3	5.9	84	w.	9.9
1.10 p. m....	712.0	23.1	72	wnw.	6.7	3,138	521.3	1.1	100	w.	16.4
1.22 p. m....	712.0	22.9	73	wnw.	5.8	3,207	516.9	1.4	87	w.	15.1
1.37 p. m....	712.0	23.0	73	wnw.	5.8	3,834	477.9	−1.5	24	w.	21.9
1.45 p. m....	712.0	23.2	71	wnw.	4.9	4,120	461.1	−2.7	13	w.	25.5
1.53 p. m....	712.0	23.4	71	wnw.	4.0	4,051	465.3	−3.0	10	w.	25.5
2.08 p. m....	712.0	23.9	70	wnw.	4.0	3,546	495.9	1.6	7	w.	21.9
2.17 p. m....	712.0	23.7	68	wnw.	3.6	3,289	511.7	0.7	17	w.	13.5
2.27 p. m....	712.0	23.9	65	wnw.	3.6	2,783	544.6	3.3	73	w.	12.1
2.40 p. m....	712.0	25.0	66	wnw.	3.1	2,463	566.7	5.7	74	wnw.	14.5
3.03 p. m....	712.0	23.8	62	nw.	5.4	1,433	641.1	14.4	79	wnw.	9.3
3.10 p. m....	712.0	23.2	65	nw.	4.9	989	675.1	19.1	67	nw.	6.6
3.18 p. m....	712.0	23.5	63	wnw.	4.9	526	712.0	23.5	63	wnw.	4.9

July 16.—Balloon ascension: One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,800 m.

There were 2/10 Ci. from the west-southwest.

Kite flight: Six kites were used; lifting surface, 40.3 sq. m. Wire out, 4,900 m.; at maximum altitude, 4,200 m.

There were 3/10 to 5/10 Ci. from the west-southwest and 3/10 to 5/10 Cu. from the south; altitude of Cu., 2,200 m.

A trough of low pressure extended from the lower Lakes to Texas and relatively high pressure covered the Atlantic coast States.

July 17.—Seven kites were used; lifting surface, 44.6 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,500 m.

There were 2/10 to 10/10 A.-Cu. from the west. There were a few St. from the west-northwest, altitude 900 m., until 12.20 p. m., and 3/10 to 6/10 Cu. from the west-northwest, altitude 2,500 m., thereafter.

Pressure was low over Maryland and high over Nebraska.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 18:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7.07 a. m....	717.2	15.3	78	nw.	7.6	526	717.2	15.3	78	nw.	7.6
7.17 a. m....	717.3	15.6	75	nw.	7.6	904	686.1	14.4	44	nnw.	12.7
7.38 a. m....	717.3	15.9	75	nw.	5.8	1,372	649.0	11.9	61	nnw.	9.8
8.13 a. m....	717.5	16.9	76	nw.	5.4	1,762	619.7	9.7	52	nw.	9.5
8.43 a. m....	717.5	17.2	63	nw.	5.4	2,223	587.3	5.5	50	wnw.	7.3
8.53 a. m....	717.6	17.2	65	nw.	4.5	1,757	619.7	8.8	50	nw.	10.0
9.02 a. m....	717.6	17.8	62	nw.	4.9	1,427	645.0	9.8	60	nnw.	10.4
9.08 a. m....	717.6	17.5	60	nw.	5.4	1,211	661.9	10.8	31	nnw.	8.7
9.16 a. m....	717.7	17.4	59	nw.	5.4	785	696.3	14.2	56	nnw.	7.8
9.21 a. m....	717.7	17.8	60	nw.	5.4	526	717.7	17.8	60	nw.	5.4
July 19:											
1.03 p. m....	719.0	22.9	44	s.	3.9	526	719.0	22.9	44	s.	3.9
1.30 p. m....	718.8	22.8	52	sse.	4.0	786	697.7	19.5	51	sse.	8.8
1.52 p. m....	718.7	22.8	54	se.	6.0	1,339	654.0	16.6	62	ssw.	9.9
2.11 p. m....	718.6	24.0	47	se.	6.5	1,616	633.1	13.0	66	sw.	11.7
2.27 p. m....	718.4	23.9	45	s.	6.3	2,129	595.3	9.0	72	sw.	10.8
3.07 p. m....	718.2	23.4	50	se.	6.5	2,459	571.8	5.7	84	sw.	8.7
3.24 p. m....	718.1	24.5	49	sse.	6.3	1,792	619.5	11.5	68	w.	8.0
3.34 p. m....	718.0	24.3	47	se.	8.3	1,229	662.0	16.5	59	ssw.	9.0
3.41 p. m....	717.9	24.2	47	sse.	7.6	813	694.7	19.9	52	s.	10.8
3.49 p. m....	717.9	24.4	47	sse.	7.4	526	717.9	24.4	47	sse.	7.4
July 20:											
10.22 a. m....	717.1	25.8	56	s.	1.3	526	717.1	25.8	56	s.	1.3
10.31 a. m....	717.1	25.8	54	ese.	3.1	1,893	612.0	13.5	......	wnw.	....
10.55 a. m....	717.1	25.7	57	ese.	2.7	1,315	654.9	17.8	......	w.	....
11.05 a. m....	717.1	25.7	57	e.	2.7	825	693.2	22.3	......	se.	....
11.10 a. m....	717.1	25.9	57	e.	2.7	526	717.1	25.9	57	e.	2.7
July 21:											
6.27 a. m....	713.1	20.9	71	wnw.	9.8	526	713.1	20.9	71	wnw.	9.8
6.40 a. m....	713.1	20.9	72	wnw.	10.3	1,024	673.2	19.6	61	nw.	10.4
7.56 a. m....	713.1	22.0	71	wnw.	9.8	1,680	623.7	14.2	73	wnw.	6.3
9.38 a. m....	713.1	24.3	62	w.	8.5	526	713.1	24.3	62	w.	8.5

July 18.—Four kites were used; lifting surface, 25.7 sq. m. Wire out, 2,900 m.; at maximum altitude, 2,400 m.

There were about 5/10 Ci.-St. from the southwest.

Pressure was low over New England and high over West Virginia.

July 19.—Five kites were used; lifting surface, 38.9 sq. m. Wire out, 3,750 m.; at maximum altitude, 2,900 m.

There were 5/10 to 1/10 Ci.-St. and, at 3:07, 4/10 A.-St., all from the west.

Low pressure central over the upper Lakes, extended to the extreme Southwest. Pressure was high over the Atlantic States and over Florida.

July 20.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 2/10 to 5/10 A.-Cu. from the west-northwest.

Pressure was high over Lake Michigan and Florida and low over the lower St. Lawrence valley.

July 21.—Six kites were used; lifting surface, 38.3 sq. m. Wire out, 4,300 m., at maximum altitude.

The sky was 4/10 to 8/10 covered with Ci.,A.-Cu. and Cu., all from the west-northwest.

Pressure was low north of the lower Lakes and relatively high over Florida.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 22:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.27 a. m....	712.3	17.2	82	nnw.	7.2	526	712.3	17.2	82	nnw.	7.2
6.33 a. m....	712.4	17.2	84	nw.	7.2	877	683.7	15.1	81	nw.	11.2
6.43 a. m....	712.4	17.4	83	nw.	6.7	1,364	645.4	11.2	85	nw.	18.9
6.58 a. m....	712.4	17.6	84	nw.	6.7	1,831	610.3	10.7	64	wnw.	21.9
7.12 a. m....	712.4	17.7	82	nw.	5.8	2,364	572.5	8.2	28	wnw.	24.2
7.37 a. m....	712.5	18.1	82	nw.	6.3	3,269	512.6	1.0	21	wnw.	19.7
8.07 a. m....	712.5	18.6	81	nw.	6.7	3,884	474.6	− 4.7	10	wnw.	26.0
8.48 a. m....	712.5	19.2	76	nw.	8.0	5,134	403.4	−13.1	8	wnw.	28.4
9.29 a. m....	712.6	20.0	66	nw.	7.6	4,073	462.7	− 6.9	7	wnw.	21.0
9.51 a. m....	712.6	20.4	63	nw.	6.7	3,297	510.1	0.9	7	wnw.	20.1
10.12 a. m....	712.6	20.9	62	nw.	6.3	2,518	561.4	6.2	6	wnw.	20.4
10.22 a. m....	712.6	20.7	65	nw.	7.6	1,907	604.6	6.4	33	nw.	16.2
10.37 a. m....	712.7	21.0	61	nw.	5.4	1,342	647.5	10.5	63	nw.	12.9
10.48 a. m....	712.7	21.2	56	nw.	6.7	847	686.7	16.2	62	nw.	12.6
10.54 a. m....	712.7	21.3	56	nw.	6.7	526	712.7	21.3	56	nw.	6.7
July 23:											
1.08 p. m....	714.9	25.8	34	s.	6.3	526	714.9	25.8	34	s.	6.3
1.20 p. m	714.9	25.7	37	s.	5.8	830	690.6	20.7	36	s.	9.0
1.38 p. m....	714.8	25.8	35	s.	6.3	1,060	672.3	17.6	41	ssw.	9.9
2.07 p. m....	714.6	26.8	34	s.	6.3	1,447	642.3	14.0	46	ssw.	10.7
2.17 p. m....	714.5	26.9	35	s.	5.8	2,181	588.3	7.8	55	ssw.	11.2
2.48 p. m....	714.3	25.9	35	s.	7.2	2,245	583.5	9.1	31	sw.	15.3
2.52 p. m....	714.3	25.9	35	s.	7.2	2,749	549.2	7.5	19	sw.	13.0
3.17 p. m....	714.0	25.8	36	s.	6.7	4,339	451.1	−3.8	17	w.	23.5
3.35 p. m....	714.0	25.6	38	s.	6.3	3,940	474.4	−1.5	18	w.	22.1
3.58 p. m....	713.9	26.1	41	s.	7.2	3,375	509.0	4.1	17	wsw.	22.1
4.16 p. m....	713.9	26.0	40	s.	6.3	2,650	555.7	9.5	7	sw.	16.3
4.20 p. m....	713.9	26.0	40	s.	6.3	2,433	570.5	6.4	15	ssw.	14.1
4.30 p. m....	713.8	26.0	40	s.	7.6	1,913	607.3	10.1	53	ssw.	13.9
4.42 p. m....	713.8	25.9	40	s.	7.6	1,284	654.2	16.9	50	s.	14.1
4.53 p. m....	713.8	25.8	39	s.	7.6	934	681.4	20.8	42	s.	12.2
5.01 p. m....	713.8	25.4	42	sse.	7.6	526	713.8	25.4	42	sse.	7.6

July 22.—Five kites were used; lifting surface, 33.5 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,800 m.

There were a few to 8/10 St.-Cu. from the northwest at an altitude of 1,300 m.

Pressure was low along the north Atlantic coast and high over Illinois.

July 23.—Six kites were used; lifting surface, 40.3 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,900 m.

There were 4/10 to 9/10 A.-Cu. and A.-St. from the west.

Pressure was high over Virginia and low over Iowa.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel-hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
July 24:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.22 a. m....	710.1	22.8	76	wsw.	7.4	526	710.1	22.8	76	wsw.	7.4
6.29 a. m....	710.1	22.9	74	sw.	7.8	941	677.0	19.8	78	wsw.	18.0
6.42 a. m....	710.0	23.4	72	sw.	6.1	1,476	636.1	16.0	89	w.	21.5
6.52 a. m....	710.0	23.7	70	sw.	5.8	1,994	598.5	15.4	69	w.	20.7
6.59 a. m....	710.0	23.9	69	sw.	6.3	2,309	576.8	12.8	65	w.	19.0
7.08 a. m....	710.0	24.1	70	sw.	6.5	2,816	542.9	8.4	69	w.	26.1
7.22 a. m....	710.0	24.4	69	wsw.	6.0	3,523	498.5	4.6	41	wsw.	24.3
7.50 a. m....	710.0	24.9	67	wsw.	6.3	3,946	472.9	0.8	39	wsw.	27.0
8.12 a. m....	710.0	25.2	70	wsw.	6.8	4.445	444.8	−2.1	21	wsw.	30.3
8.59 a. m....	710.0	26.1	75	sse.	6.9	3,877	478.0	2.4	7	wsw.	25.3
9.21 a. m....	710.0	26.3	72	wsw.	5.0	3,405	506.4	6.8	32	w.	21.6
9.53 a. m....	710.0	27.8	57	sw.	8.0	2,801	544.7	10.8	48	wsw.	20.4
10.13 a. m....	710.0	28.4	56	wsw.	8.1	2,075	593.7	15.9	32	w.	18.2
10.20 a. m....	710.0	28.1	54	sw.	8.0	1,843	610.0	15.7	61	w.	17.0
10.27 a. m....	710.0	27.9	57	sw.	7.6	1,392	643.0	18.1	78	w.	15.3
10.36 a. m....	709.9	28.0	57	sw.	6.7	971	675.0	22.2	72	w.	13.6
10.47 a. m....	709.9	28.8	52	wsw.	6.0	526	709.9	28.8	52	wsw.	6.0
July 25:											
6.42 a. m....	714.9	13.8	55	wnw.	8.9	526	714.9	13.8	55	wnw.	8.9
6.52 a. m....	715.0	13.8	55	wnw.	9.4	1,064	670.6	7.8	57	wnw.	17.6
7.09 a. m....	715.1	14.2	55	wnw.	13.0	1,708	619.8	4.3	56	nw.	27.0
7.20 a. m....	715.1	14.4	53	w.	13.9	2,566	558.2	8.1	33	wnw.	24.3
7.45 a. m....	715.2	14.6	52	wnw.	11.6	3,182	518.2	3.6	20	wnw.	24.2
8.05 a. m....	715.2	14.8	53	w.	13.4	3,818	478.9	−0.5	19	wnw.	30.6
8.28 a. m....	715.3	15.4	50	w.	13.9	4,630	432.0	−6.5	14	w.	33.3
8.43 a. m....	715.4	15.6	54	wnw.	10.7	3,968	469.4	−1.3	12	w.	27.9
9.08 a. m....	715.5	16.2	50	w.	12.5	3,541	495.3	1.4	11	w.	26.1
9.23 a. m....	715.5	16.3	51	w.	10.3	2.174	586.2	4.8	12	wnw.	29.2
9.39 a. m....	715.7	16.7	50	wnw.	10.7	1,913	605.4	1.7	34	wnw.	19.9
9.46 a. m....	715.7	16.9	49	w.	10.7	1.596	629.6	3.4	55	wnw.	14.5
10.03 a. m....	715.8	17.8	49	wnw.	9.8	526	715.8	17.8	49	wnw.	9.8
July 26:											
1.22 p. m....	719.3	21.6	46	s.	3.1	526	719.3	21.6	46	s.	3.1
1.34 p. m....	719.2	21.3	46	w.	1.8	2,320	581.8	5.7	......	wsw.	....
1.57 p. m....	719.0	23.2	40	ene.	1.8	1,679	628.5	12.3	......	calm	....
2.09 p. m....	719.0	21.6	46	nw.	1.3	935	685.8	17.6	......	calm.	....
2.12 p. m....	719.0	21.4	46	nw.	1.3	526	719.0	21.4	46	nw.	1.3

July 24.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 8,000 m.; at maximum altitude, 7,450 m.

Cloudiness decreased from 8/10 St.-Cu. from the southwest and 1/10 A.-St. and Ci.-St., direction indeterminable, at the beginning of the flight to 2/10 St. and 1/10 A.-St. and Ci.-St. from the west at 6.30 a. m. The degree of cloudiness varied but slightly thereafter.

Low pressure was central over Ontario and northern Lake Huron. Pressure was high off the south Atlantic coast.

July 25.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 8,300 m.; at maximum altitude, 8,000 m.

There were a few Ci.-Cu. and Cu. both from the west; altitude of Cu. about 1,600 m.

Pressure was low over Quebec and high from the Dakotas to Texas.

July 26.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m.

There were about 7/10 Cu. from the southwest.

A large high, central over the Mississippi Valley, covered the Middle and Eastern States. Pressure was low over the lower St. Lawrence Valley.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
				Wind.						Wind.	
	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.	Height.	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.
1911.											
July 27:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.40 p. m....	720.8	24.8	42	e.	5.8	526	720.8	24.8	42	e.	5.8
3.35 p. m....	720.4	23.1	51	e.	5.4	1,242	663.1	15.5	63	e.	8.0
3.53 p. m....	720.4	23.0	51	e.	4.9	1,536	640.3	12.1	73	e.	11.1
4.07 p. m....	720.4	23.5	49	e.	4.9	1,011	681.2	17.6	58	e.	8.2
4.17 p. m....	720.3	23.4	47	e.	5.4	526	720.3	23.4	47	e.	5.4
July 28:											
1.33 p. m....	719.8	24.8	44	n.	2.2	526	719.8	24.8	44	n.	2.2
1.55 p. m....	719.7	25.0	40	ne.	3.1	2,410	576.8	8.8	......	calm.	......
2.06 p. m....	719.7	24.8	38	n.	2.2	1,684	629.2	13.2	......	n.	......
2.16 p. m....	719.7	24.6	38	n.	2.7	1,437	647.7	15.5	......	n.	......
2.23 p. m....	719.7	25.2	36	nw.	2.7	939	686.5	19.9	......	calm.	......
2.30 p. m....	719.6	24.9	33	n.	2.7	526	719.6	24.9	33	n.	2.7
July 29:											
11.27 a. m...	719.3	28.2	31	wsw.	5.4	526	719.3	28.2	31	wsw.	5.4
11.39 a. m...	719.2	28.2	31	sw.	3.6	1,860	617.8	15.6	......	wsw.	......
12.00 m......	719.1	28.9	32	sw.	3.6	1,090	674.6	21.5	......	sw.	......
12.10 p. m...	719.1	28.4	30	wnw.	4.0	526	719.1	28.4	30	wnw.	4.0
July 30:											
1.36 p. m....	720.9	25.0	56	wnw.	3.2	526	720.9	25.0	56	wnw.	3.2
1.43 p. m....	720.8	25.0	56	sw.	3.5	1,114	673.6	17.4	......	sw.	......
1.45 p. m....	720.8	25.0	56	sw.	3.5	1,187	668.0	17.9	......	sw.	......
1.53 p. m....	720.8	24.8	57	sw.	2.9	1,774	623.5	12.6	......	w.	......
2.13 p. m....	720.7	24.7	57	s.	2.0	1,383	652.8	15.2	......	sw.	......
2.18 p. m....	720.7	24.8	62	ese.	2.0	1,069	677.3	19.8	......	ssw.	......
2.27 p. m....	720.6	24.2	60	s.	3.0	526	720.6	24.2	60	s.	3.0
July 31:											
1.23 p. m....	718.8	27.6	62	wsw.	3.8	526	718.8	27.6	62	wsw.	3.8
1.47 p. m....	718.8	27.6	48	sse.	3.4	2,231	589.4	11.3	......	n.	......
2.03 p. m....	718.8	27.4	52	s.	2.2	1,344	654.4	17.3	......	e.	......
2.11 p. m....	718.8	27.1	53	ene.	2.2	926	686.8	21.4	......	e.	......
2.16 p. m....	718.8	27.0	53	ene.	2.5	526	718.8	27.0	53	ene.	2.5

July 27.—Three kites were used; lifting surface, 25.8 sq. m. Wire out, 2,100 m.; at maximum altitude, 1,600 m.

There were from 3/10 to 7/10 Cu., of which the upper layer was moving from the west-southwest and the lower layer from the east-northeast.

High pressure, central over New York, covered the eastern United States. Pressure was relatively low off the South Atlantic coast.

July 28.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 1/10 Cu. from the north, and a few Ci. near the north horizon.

A ridge of high pressure extended from Maine southwestward. Pressure was low off the Middle Atlantic coast.

July 29.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,800 m.

There were 6/10 to 3/10 Ci.-Cu., and 1/10 to 5/10 Cu., all from the west.

Pressure was low over Maine and high over North Carolina.

July 30.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,150 m.

There were 1/10 A.-St., direction indeterminable, 2/10 to 6/10 St. and St.-Cu. from the east-southeast, and 2/10 to 4/10 Cu. from the west.

Pressure was low over the Dakotas and high over West Virginia.

July 31.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,800 m.

There were 5/10 Cu., direction, north-northeast to east-northeast.

Low pressure was central over northwestern Iowa and high pressure over the Middle and South Atlantic States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 1:											
First flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.12 a. m....	718.1	20.8	88	se.	7.2	526	718.1	20.8	88	se.	7.2
8.16 a. m....	718.1	21.1	88	se.	7.2	862	690.7	18.8	67	se.	11.7
8.49 a. m....	718.1	21.6	85	se.	7.6	1,238	661.3	18.8	56	se.	8.6
10.07 a. m....	718.1	23.9	76	se.	8.5	1,542	638.4	16.3	64	sse.	4.1
10.20 a. m....	718.1	24.0	73	se.	9.8	1,058	675.4	20.5	52	sse.	5.9
10.40 a. m....	718.1	24.6	70	se.	8.5	865	690.7	18.8	84	se.	13.5
10.45 a. m....	718.1	24.6	70	se.	8.9	526	718.1	24.6	70	se.	8.9
Second flight—											
2.34 p. m....	717.3	27.7	52	se.	8.0	526	717.3	27.7	52	se.	8.0
2.40 p. m....	717.2	27.8	51	se.	6.3	790	696.2	23.3	56	se.	8.1
3.24 p. m....	716.9	28.6	50	se.	7.2	1,191	664.7	19.5	67	se.	8.6
3.56 p. m....	716.8	28.1	51	se.	7.2	1,569	636.0	14.9	74	sse.	8.7
4.13 p. m....	716.7	28.3	49	se.	6.7	1,844	615.6	13.5	69	s.	9.7
5.24 p. m....	716.2	27.6	50	se.	8.5	526	716.2	27.6	50	se.	8.5
Aug. 2:											
1.04 p. m....	718.3	28.0	50	sse.	7.2	526	718.3	28.0	50	sse.	7.2
2.10 p. m....	718.0	28.2	51	sse.	5.4	947	684.6	22.1	57	s.	8.0
2.24 p. m....	717.9	28.0	52	sse.	5.4	1,400	649.6	18.5	74	s.	8.2
3.15 p. m....	717.7	27.4	54	s.	4.5	1,647	631.0	16.2	80	ssw.	......
3.33 p. m....	717.7	27.2	57	s.	3.6	526	717.7	27.2	57	s.	3.6
Aug. 3:											
11.17 a. m....	719.5	22.8	90	se.	5.4	526	719.5	22.8	90	se.	5.4
11.32 a. m....	719.5	24.2	82	se.	5.8	883	690.6	19.2	95	se.	10.4
11.44 a. m....	719.5	24.5	81	se.	7.6	1,301	657.9	17.0	80	sse.	14.0
11.54 a. m....	719.4	24.6	80	se.	8.0	1,535	640.0	16.7	66	s.	14.0
1.13 p. m....	718.9	26.8	66	se.	8.9	2,545	567.7	9.5	......	s.	......
1.48 p. m....	718.7	26.6	65	ese.	5.4	526	718.7	26.6	65	ese.	5.4

August 1.—First flight: Six kites were used; lifting surface, 39.8 sq. m. Wire out, 4,000 m.; at maximum altitude, 3,700 m.

There were 5/10 to 7/10 low St. moving rapidly from the southeast; altitude, 800 m.

Second flight: Six kites were used; lifting surface, 43.2 sq. m. Wire out, 4,000 m.; at maximum altitude, 3,000 m.

There were 4/10 to 7/10 Cu. and St.-Cu. from the south.

Pressure was high off the New England coast. Low pressure was central over Wisconsin.

August 2.—Four kites were used; lifting surface, 25.7 sq. m. Wire out, 2,400 m.; at maximum altitude, 1,700 m.

The sky was about 7/10 overcast with Ci. and A.-Cu. from the west and St.-Cu. from the south.

Low pressure was central north of Lake Superior. Pressure was high off the coast of Maine.

August 3.—Five kites were used; lifting surface, 34.0 sq. m. Wire out, 4,150 m.; at maximum altitude, 3,500 m.

There were 6/10 clouds consisting of Ci.-Cu. from the northwest, Cu. from the south, and St. from the southeast; altitude of St., 1,300 m.

Pressure was high along the New England coast and low over Nebraska, with a secondary depression over Ohio.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 4:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
3.06 p. m...	716.8	25.2	70	sse.	6.8	526	716.8	25.2	70	sse.	6.8
3.17 p. m...	716.7	26.7	64	sse.	6.4	2,193	590.5	12.7	......	ssw.	....
3.38 p. m...	716.6	24.6	73	s.	5.6	1,664	628.4	15.1	......	sw.	....
3.52 p. m...	716.6	25.1	72	se.	6.8	1,129	668.9	19.5	......	se.	....
3.57 p. m...	716.6	25.1	73	s.	6.0	526	716.6	25.1	73	s.	6.0
Aug. 5:											
11.25 a. m....	716.9	20.9	95	e.	3.1	526	716.9	20.9	95	e.	3.1
11.45 a. m....	716.8	20.6	96	e.	2.2	2,162	592.1	14.6	......	calm.	....
11.51 a. m....	716.8	20.7	96	ese.	2.7	1,735	622.6	14.6	......	calm.	....
12.07 p. m...	716.8	21.0	96	ene.	2.7	526	716.8	21.0	96	ene.	2.7
Aug. 6:											
10.26 a. m....	718.3	20.6	91	e.	3.6	526	718.3	20.6	91	e.	3.6
10.50 a. m....	718.3	21.0	89	ese.	2.7	1,704	625.9	14.2	......	ese.	....
11.00 a. m....	718.3	21.0	89	e.	2.7	936	685.0	17.5	......	e.	....
11.17 a. m....	718.3	21.0	89	e.	2.7	526	718.3	21.0	89	e.	2.7
Aug. 7:											
1.20 p. m...	717.1	24.4	76	se.	6.7	526	717.1	24.4	76	se.	6.7
2.05 p. m...	716.8	24.7	63	ese.	6.7	950	682.9	20.3	62	se.	8.9
4.05 p. m...	716.5	25.3	68	ese.	7.6	1,088	671.8	19.5	74	sse.	6.5
4.23 p. m...	716.4	25.0	63	ese.	7.6	1,334	652.7	16.6	91	sse.	9.4
4.29 p. m...	716.4	25.0	64	ese.	6.7	1,048	674.8	18.7	80	sse.	10.8
4.38 p. m...	716.4	25.1	63	ese.	8.5	906	686.0	21.0	78	se.	11.7
4.43 p. m...	716.4	24.8	61	se.	8.0	526	716.4	24.8	61	se.	8.0

August 4.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,200 m. There were 4/10 Cu. and St.-Cu. from the southwest and 4/10 A.-St. from the southeast.

Pressure was low over Minnesota and eastern North Dakota and high off the New England coast with a secondary crest over southern Virginia.

August 5.—One captive balloon was used; capacity, 22.4 cu. m.

The sky was covered with St. whose lower strata moved from the southeast until 11.45 a. m., and from the east-northeast thereafter, no motion was apparent in the higher strata. At noon St.-Cu., moving slowly from the west, was seen through a rift in the St. The balloon entered clouds at an altitude of 1,450 m. Light rain fell from 11.45 a. m. until noon.

Pressure was relatively low off the South Carolina coast and west of the Mississippi, and was relatively high from Mississippi to West Virginia and from Maryland to New England.

August 6.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,650 m. There were 10/10 St.-Cu. from the east. The base of the clouds was about 500 m. above the ground.

Low pressure was central off the Carolina coast. Pressure was high off the New England coast.

August 7.—Five kites were used; lifting surface, 34.0 sq. m. Wire out, 3,000 m.; at maximum altitude, 1,200 m.

There were 2/10 to a few Cu. from the southeast.

Pressure was high from Maine to Louisiana and low over Minnesota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 8:	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
6.39 a. m....	716.0	19.6	88	s.	6.7	526	716.0	19.6	88	s.	6.7
6.50 a. m....	716.1	19.8	88	s.	6.7	807	693.3	20.6	77	sw.	9.6
7.17 a. m....	716.1	19.8	88	s.	5.4	1,247	658.8	17.8	84	wsw.	7.4
8.52 a. m....	716.0	21.1	90	ese.	4.9	834	691.2	21.5	77	sw.	8.5
8.57 a. m....	716.0	20.8	91	ese.	5.4	526	716.0	20.8	91	ese.	5.4
Aug. 9:											
6.23 a. m....	716.1	22.0	81	wnw.	5.8	526	716.1	22.0	81	wnw.	5.8
6.32 a. m....	716.0	22.2	78	nw.	6.7	900	686.1	23.1	57	nnw.	13.3
7.14 a. m....	716.1	22.6	78	nw.	5.4	1,452	644.0	20.5	54	nnw.	7.9
8.05 a. m....	716.3	22.7	79	nw.	6.3	1,973	606.2	14.5	69	nnw.	6.3
8.38 a. m....	716.5	23.6	82	nnw.	5.4	2,473	571.4	11.6	66	n.	8.5
8.55 a. m....	716.6	23.6	82	nw.	6.0	2,079	598.6	14.2	70	nnw.	8.0
9.22 a. m....	716.6	24.0	83	nnw.	7.8	1,232	660.9	20.4	61	nnw.	11.6
9.36 a. m....	716.7	24.4	83	nnw.	7.6	780	696.3	21.6	65	nnw.	14.1
9.38 a. m....	716.7	24.6	83	nnw.	8.5	526	716.7	24.6	83	nnw.	8.5
Aug. 10:											
First flight—											
1.23 p. m....	719.6	28.4	55	se.	2.7	526	719.6	28.4	55	se.	2.7
1.42 p. m....	719.7	28.9	53	se.	3.6	2,508	572.9	14.1	......	n.	....
1.54 p. m....	719.7	28.8	52	se.	2.7	2,033	605.7	17.5	......	nnw.	....
2.04 p. m ..	719.7	28.9	52	se.	2.2	1,607	636.4	20.0	......	nnw.	....
2.17 p. m....	719.7	29.0	52	se.	2.7	1,093	675.0	23.2	......	calm.	....
2.25 p. m....	719.7	29.2	51	se.	2.7	526	719.7	29.2	51	se.	2.7

August 8.—Six kites were used; lifting surface, 40.8 sq. m. Wire out, 3,800 m.; at maximum altitude, 2,000 m.

There were about 9/10 A.-Cu. and St.-Cu., from the west-northwest. About 1/10 St. from the south and southeast, passed under the kites between 8.45 and 8.50 a. m.

Pressure was low over the Lake region, and was high off the northern and middle Atlantic coast.

August 9.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 3,800 m., at maximum altitude, 3,000 m.

There were 2/10 Ci.-St. from the west-northwest and 1/10 St.-Cu. from the north-northwest near the beginning of the flight. After 7 a. m. there were a few Ci.-Cu. from the southwest and a few Ci-St. from the west-northwest. There was light haze.

Pressure was low over the lower St. Lawrence Valley and high over the Ohio Valley.

August 10.—First flight: One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m.

There were 5/10 to 3/10 Ci.-St. from the northwest.

At 8 a. m. pressure was low over the Gulf of St. Lawrence and the middle Mississippi Valley and high over North Dakota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 10-11:											
Second flight—	*mm.*	°*C.*	%		*m. p. s.*	*m.*	*mm.*	°*C.*	%		*m. p. s.*
7.15 p. m....	718.7	26.6	54	se.	4.0	526	718.7	26.6	54	se.	4.0
7.33 p. m....	718.8	26.4	54	sse.	4.0	1,299	658.4	22.8	......	calm.	....
7.42 p. m....	718.8	26.1	56	sse.	4.0	1,784	622.7	20.6	......	calm.	....
8.17 p. m....	718.9	26.2	44	sse.	4.9	2,271	588.7	16.0	......	calm.	....
8.53 p. m....	719.0	26.4	41	sse.	4.9	2,242	590.5	16.7	......	calm.	....
9.00 p. m....	719.0	26.3	41	sse.	5.4	2,239	590.5	16.1	......	calm.	....
9.57 p. m....	719.2	25.6	48	s.	5.4	2,161	595.8	16.2	......	calm.	....
10.14 p. m....	719.2	25.5	49	s.	5.4	2,160	595.8	15.8	......	calm.	....
10.58 p. m....	719.2	25.3	51	s.	5.4	2,160	595.8	16.1	......	calm.	....
11.50 p. m....	719.0	25.4	50	ssw.	5.4	1,985	608.3	17.0	......	....	....
Aug. 11:											
12.00 m......	719.0	25.4	59	ssw.	5.4	1,711	628.1	19.0	......	....	....
12.10 a. m....	718.9	25.4	58	ssw.	5.4	923	687.3	25.0	......	sw.	....
12.33 a. m....	718.8	25.2	58	ssw.	5.4	526	718.8	25.2	58	ssw.	5.4
Aug. 11:											
First flight (instrument in head kite)—											
1.26 a. m....	718.6	24.7	60	ssw.	4.5	526	718.6	24.7	60	ssw.	4.5
1.42 a. m....	718.6	25.0	58	sw.	4.5	940	685.7	23.7	47	sw.	12.6
2.44 a. m....	718.6	24.9	62	wsw.	4.5	1,120	671.6	22.6	41	wsw.	7.6
3.17 a. m....	718.6	24.6	63	wsw.	4.0	1,265	660.6	21.6	39	wsw.	7.6
3.39 a. m....	718.6	24.4	64	w.	4.5	1,389	651.7	22.0	17	wsw.	6.0
4.34 a. m....	718.6	23.9	67	wsw.	3.2	758	700.0	27.7	21	wsw.	6.5
Instrument in secondary kite—											
3.11 a. m....	718.6	24.7	63	wsw.	4.0	825	694.7	25.2	......	wsw.	....
5.03 a. m....	718.6	24.1	65	wsw.	2.7	709	704.0	28.6	......	wsw.	....
5.21 a. m....	718.6	24.5	63	wsw.	4.9	1,148	670.0	25.3	......	wsw.	....
5.28 a. m....	718.6	24.6	62	wsw.	4.0	802	696.6	27.5	......	wsw.	....
5.55 a. m....	718.6	24.2	65	wsw.	3.6	526	718.6	24.2	65	wsw.	3.6
Aug. 11:											
Second flight—											
8.08 a. m....	718.5	25.4	59	wsw.	7.6	526	718.5	25.4	59	wsw.	7.6
8.15 a. m ...	718.5	25.4	59	wsw.	7.6	834	694.0	26.4	42	w.	10.4
8.26 a. m....	718.5	25.2	63	wsw.	7.6	1,149	669.7	25.1	36	wnw.	11.7
9.22 a. m....	718.5	26.0	61	w.	7.6	1,599	636.2	20.9	30	wnw.	7.6
9.43 a. m....	718.4	26.8	61	w.	6.3	2,440	576.4	11.9	42	wnw.	12.6
10.40 a. m....	718.3	29.3	53	wsw.	4.5	3,124	531.0	4.7	56	nw.	10.0
11.33 a. m....	718.1	30.0	49	sw.	4.5	2,620	564.3	10.2	56	wnw.	7.8
12.08 p. m...	718.0	30.8	49	wsw.	4.5	2,067	602.5	16.3	51	wnw.	12.2
1.02 p. m...	718.0	32.1	47	wsw.	3.1	1,492	644.0	22.9	53	wnw.	....
1,10 p. m...	717.9	32.3	46	wsw.	4.5	1,015	679.8	26.1	50	wnw.	....
1.39 p. m...	717.6	33.0	45	wsw.	2.7	526	717.6	33.0	45	wsw.	2.7

Second flight: One captive balloon was used, capacity 22.4 cu. m. Wire out, 1,750 m.

A few Ci. from the west-northwest were present until 11 p. m. The sky was cloudless thereafter.

At 8 p. m. of the 10th pressure was low over the Gulf of St. Lawrence and the middle Mississippi Valley and high over North Dakota and off the South Atlantic States.

August 11.—First flight: Four kites were used; lifting surface, 27.2 sq. m. Wire out 2,800 m.; at maximum altitude, 1,400 m.

The sky was cloudless until 5.30 a. m., when a few St.-Cu. from the west-southwest appeared.

Second flight: Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,400 m.

There were a few Ci.-St., direction doubtful, after 10.00 a. m. At 8 a. m. pressure was high over eastern North Dakota. Centers of low pressure were over the Gulf of Mexico and New York.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel-hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 12:	*mm.*	°*C.*	%		*m. p. s.*	*m.*	*mm.*	°*C.*	%		*m. p. s.*
8.48 a. m....	721.4	20.2	76	nnw.	2.2	526	721.4	20.2	76	nnw.	2.2
9.04 a. m....	721.5	19.8	75	n.	1.8	1,947	611.3	18.1	......	wnw.	....
9.26 a. m....	721.6	20.6	72	se.	2.2	1,650	632.9	19.1	......	nw.	....
9.37 a. m....	721.6	20.7	72	nne.	2.7	1,453	647.6	14.6	......	nw.	....
9.50 a. m....	721.7	21.1	69	e:	3.1	1,300	659.5	15.3	......	nw.	....
10.00 a. m....	721.7	21.4	68	e.	3.1	957	686.5	18.1	......	calm.	....
10.06 a. m....	721.8	21.7	67	ese.	3.1	935	688.4	16.8	......	calm.	....
10.11 a. m....	721.8	21.7	67	ene.	2.7	526	721.8	21.7	67	ene.	2.7
Aug. 13:											
8.47 a. m....	720.5	21.8	85	wsw.	1.3	526	720.5	21.8	85	wsw.	1.3
8.56 a. m....	720.5	22.4	81	wsw.	1.3	1,436	648.5	17.7	......	nw.	....
9.20 a. m....	720.6	22.5	82	w.	3.6	891	691.1	19.7	......	nw.	....
9.27 a. m....	720.6	23.4	73	w.	3.6	526	720.6	23.4	73	w.	3.6
Aug. 14:											
8.29 a. m....	719.3	21.7	86	wnw.	6.7	526	719.3	21.7	86	wnw.	6.7
8.44 a. m....	719.4	21.5	88	wnw.	7.2	1,002	681.0	20.5	65	nw.	10.4
9.24 a. m....	719.4	21.4	90	nw.	6.3	1,379	651.9	17.5	66	nnw.	9.9
9.57 a. m....	719.5	22.3	92	nw.	7.2	2,185	592.8	10.6	68	nnw.	7.2
10.57 a. m....	719.4	22.6	84	nnw.	9.8	2,676	558.4	5.9	86	nnw.	12.2
11.26 a. m....	719.3	22.6	74	nw.	8.9	2,359	580.5	9.8	78	nw.	9.2
11.51 a. m....	719.2	22.1	77	nw.	6.7	1,678	629.2	15.3	69	wnw.	13.9
12.04 p. m....	719.2	22.0	81	nw.	3.6	1,283	658.9	18.3	61	nw.	12.7
12.10 p. m....	719.2	22.0	81	nw.	3.6	818	695.4	19.9	65	nw.	8.9
12.13 p. m....	719.2	22.6	79	nw.	3.2	526	719.2	22.6	79	nw.	3.6
Aug. 15:											
11.32 a. m....	713.9	24.0	73	wsw.	4.5	526	713.9	24.0	73	wsw.	4.5
11.40 a. m....	713.9	24.5	71	wsw.	5.4	851	687.9	21.2	......	wsw.	....
11.52 a. m....	713.8	24.1	74	wsw.	5.4	1,294	653.4	18.4	......	w.	....
12.11 p. m....	713.8	24.2	73	wsw.	5.4	1,828	614.0	15.1	......	w.	....
12.50 p. m....	713.7	23.8	73	wsw.	5.4	2,495	566.9	8.0	......	w.	....
1.00 p. m....	713.7	23.8	72	wsw.	4.9	3,009	532.5	6.1	......	w.	....
1.33 p. m....	713.6	23.8	73	wsw.	5.8	2,275	581.9	10.2	......	w.	....
1.46 p. m....	713.5	23.8	73	wsw.	5.4	1,694	623.1	15.3	......	w.	....
1.58 p. m....	713.5	23.8	71	wsw.	6.4	1,369	647.5	17.5	......	w.	....
2.09 p. m....	713.4	23.7	72	sw.	5.4	963	678.5	20.0	......	wsw.	....
2.15 p. m....	713.4	23.4	74	sw.	7.2	526	713.4	23.4	74	sw.	7.2

August 12.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,550 m. There were 10/10 St.-Cu. from the northwest; base about 1,250 m. altitude. The balloon entered St.-Cu. at 8.54 and dropped below them at 9.38 a. m.

High pressure was central over Lake Huron. Pressure was relatively low over North Carolina, and was low over Newfoundland and the Gulf of Mexico.

August 13.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,900 m. There were 4/10 to 7/10 A.-Cu. from the west. Sheets of fog were rising from the Loudoun Valley.

Pressure was high over the eastern United States, and was low over Newfoundland.

August 14.—Seven kites were used; lifting surface, 46.1 sq. m. Wire out, 5,600 m.; at maximum altitude, 5,000 m.

There were about 8/10 A.-Cu. until 10 a. m. and about 9/10 A.-Cu. and St.-Cu. from the northwest thereafter. Light rain fell from 11.30 to 11.50 a. m.

Low pressure was over Texas. Pressure was high over the South Atlantic States.

August 15.—Five kites were used; lifting surface, 33.5 sq. m. Wire out, 4,500 m.; at maximum altitude, 4,200 m.

There were 6/10 to 10/10 St.-Cu. from the west-southwest until 11.50 a. m. and from the west thereafter; altitude, 2,500 m. There were 3/10 to 2/10 A.-Cu. from the west before 11.50 a. m. Light rain fell at intervals after 12.36 p. m.

Pressure was low over Lake Erie and high over Iowa and off the Florida coast.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911. Aug. 16: *First flight—*	*mm.*	° *C.*	%		*m.p.s.*	*m.*	*mm.*	° *C.*	%		*m.p.s.*
7.09 a. m....	713.6	18.8	85	wnw.	10.3	526	713.6	18.8	85	wnw.	10.3
7.15 a. m....	713.6	19.0	85	wnw.	....	1,002	675.2	17.6	57	nnw.	24.9
7.24 a. m....	713.6	19.4	83	wnw.	12.5	1,510	636.2	14.1	41	nnw.	21.6
7.30 a. m....	713.6	19.5	83	wnw.	11.6	1,719	620.7	12.6	36	nnw.	21.6
7.35 a. m....	713.7	19.7	83	wnw.	12.1	2,068	595.7	13.7	23	nnw.	20.8
7.54 a. m....	713.7	20.3	79	wnw.	13.9	2,810	545.4	11.1	13	nnw.	19.2
8.15 a. m....	713.7	20.8	78	wnw.	11.6	3,233	518.4	7.5	10	nnw.	18.7
8.36 a. m....	713.9	21.2	74	wnw.	12.1	2,673	554.6	11.5	9	nnw.	17.7
8.56 a. m....	713.9	21.7	73	wnw.	13.9	2,043	597.5	16.3	8	nnw.	18.4
9.04 a. m....	713.9	21.9	68	wnw.	12.5	1,486	638.2	12.9	15	nnw	19.7
9.23 a. m....	714.0	22.5	69	nw.	12.5	1,009	675.2	16.8	68	nw.	16.8
9.31 a. m....	714.0	22.9	67	wnw.	12.5	526	714.0	22.9	67	wnw.	12.5
Second flight—											
9.58 a. m....	714.1	23.6	61	wnw.	11.2	526	714.1	23.6	61	wnw.	11.2
10.06 a. m....	714.1	23.9	62	wnw.	10.7	862	687.1	19.5	64	nw.	14.0
10.15 a. m....	714.1	24.0	60	wnw.	11.2	1,212	659.6	16.4	65	nw.	16.0
10.24 a. m....	714.1	24.3	58	wnw.	11.2	1,753	618.9	13.4	44	nnw.	20.8
10.36 a. m....	714.1	24.5	57	wnw.	11.2	2,063	596.8	15.8	20	nnw.	17.6
10.52 a. m....	714.1	24.9	57	wnw.	13.4	2,726	551.7	10.8	......	nnw.	17.6
11.18 a. m....	714.1	25.3	56	nw.	10.7	3,129	525.3	6.8	13	nnw.	19.5
11.45 a. m....	714.1	26.3	54	wnw.	11.6	2,415	570.2	11.5	12	nnw.	21.6
11.50 a. m....	714.1	26.1	53	wnw.	11.6	2,088	594.8	12.6	20	nnw.	16.8
11.52 a. m....	714.1	26.0	53	wnw.	11.6	1,757	618.9	9.3	40	nnw.	16.8
12.07 p. m....	714.1	26.2	56	wnw.	8.9	1,204	660.7	17.6	67	nw.	14.4
12.17 p. m....	714.1	26.5	52	wnw.	9.8	904	684.0	21.7	61	nw.	14.4
12.21 p. m....	714.1	26.6	55	nw.	8.0	526	714.1	26.6	55	nw.	8.0
Third flight—											
12.50 p. m...	714.1	27.0	52	wnw.	9.8	526	714.1	27.0	52	wnw.	9.8
12.56 p. m...	714.1	27.0	46	wnw.	8.9	958	679.9	22.8	49	nw	12.8
1.10 p. m...	714.1	27.3	44	wnw.	9.8	1,380	647.6	18.2	59	nw.	14.5
1.19 p. m...	714.0	27.4	42	wnw.	10.7	1,766	618.9	14.0	64	nw.	13.6
1.34 p. m...	714.0	27.9	38	nw.	9.8	2,193	588.2	9.8	62	nw.	16.0
1.56 p. m...	713.9	28.0	37	nw.	9.8	2,945	537.0	5.4	46	nw.	16.8
2.22 p. m...	713.8	28.3	38	nw.	8.9	3,204	520.8	6.4	44	nnw.	18.3
2.56 p. m...	713.7	28.2	37	nw.	8.0	2,513	566.5	10.3	26	nnw.	20.0
3.12 p. m...	713.7	28.0	39	nw.	8.0	1,767	618.9	16.0	48	nnw.	13.3
3.22 p. m...	713.6	28.0	37	nw.	9.8	1,378	647.6	19.6	49	nnw.	15.2
3.32 p. m...	713.6	28.0	37	nw.	8.9	967	678.9	23.7	42	nnw.	15.2
3.39 p. m...	713.6	28.0	37	nw.	9.4	526	713.6	28.0	37	nw.	9.4

August 16.—First flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,900 m.

The sky was cloudless until about 8.15 a. m., when a few Cu. from the north-northwest appeared.

At 8 a. m. a well-developed low was central off the coast of eastern Maine and pressure was high from the Ohio Valley to Florida.

Second flight: Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5,200 m.; at maximum altitude, 4,700 m.

Cu. from the northwest increased from a few to 2/10.

Third flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,200 m.: at maximum altitude, 5,000 m.

There were from 2/10 to a few Cu. from the northwest. A few A.-St., direction not determined, appeared during the latter part of the flight.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel-hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 16:											
Fourth flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
4.15 p. m...	713.5	27.8	39	nw.	7.2	526	713.5	27.8	39	nw.	7.2
4.24 p. m...	713.5	28.0	40	nw.	7.2	902	683.8	23.9	44	nnw.	11.6
5.04 p. m...	713.6	27.9	46	nw.	4.5	1,552	634.6	16.6	67	nw.	11.6
5.14 p. m...	713.6	27.5	44	nw.	5.4	2,070	596.8	12.8	70	nw.	17.6
5.31 p. m...	713.7	27.2	48	nw.	4.5	2,713	552.9	9.3	56	nw.	24.8
5.53 p. m...	713.7	26.8	50	nw.	4.5	3,353	511.4	3.1	56	nw.	26.7
6.08 p. m...	713.7	26.7	53	nw.	2.7	2,931	538.2	5.9	48	nw.	23.5
6.21 p. m...	713.8	26.6	52	nw.	2.7	2,017	600.7	12.3	85	nw.	16.0
6.45 p. m...	713.9	25.9	53	n.	3.1	1,313	652.5	19.6	63	nw.	9.5
6.58 p. m...	714.0	25.8	53	nnw.	2.7	526	714.0	25.8	53	nnw.	2.7
Fifth flight—											
7.32 p. m...	714.0	25.6	54	nnw.	3.1	526	714.0	25.6	54	nnw.	3.1
7.41 p. m...	714.0	25.6	54	nw.	2.7	944	680.8	23.5	......	nw.	....
7.55 p. m...	714.1	25.4	55	nw.	2.2	1,297	653.8	19.9	......	nw.	....
8.05 p. m...	714.1	25.2	56	nw.	1.8	1,532	636.3	17.8	......	nw.	....
8.36 p. m...	714.3	25.2	55	wnw.	2.7	1,121	667.5	21.6	......	wnw.	....
8.57 p. m...	714.4	25.0	55	wnw.	3.6	877	686.5	23.6	......	wnw.	....
9.21 p. m...	714.4	24.4	57	wnw.	5.4	526	714.4	24.4	57	wnw.	5.4
Aug. 16–17:											
Sixth flight—											
10.10 p. m...	714.3	24.2	50	wnw.	6.3	526	714.3	24.2	50	wnw.	6.3
10.18 p. m...	714.3	24.1	56	wnw.	6.3	915	683.3	23.1	55	wnw	14.6
10.53 p. m...	714.2	24.6	58	w.	7.6	1,466	641.2	17.2	65	wnw.	12.9
11.20 p. m...	714.2	24.7	58	w.	6.7	2,262	583.7	11.6	50	nw.	13.2
11.51 p. m...	714.2	24.1	59	w.	7.6	3,430	506.8	2.3	52	nw.	19.0
Aug. 17, 1911:											
12.13 a. m....	714.1	23.8	60	w.	8.0	2,700	554.0	9.1	58	nw.	17.3
12.32 a. m....	714.0	24.0	60	w.	8.5	1,981	603.4	13.9	55	nw.	16.5
12.50 a. m....	714.0	24.2	57	w.	10.3	1,383	647.2	18.9	59	wnw.	16.4
1.02 a. m.	713.9	24.2	57	w.	10.7	938	681.2	23.3	53	wnw.	15.4
1.07 a. m.	713.9	24.1	59	w.	9.8	526	713.9	24.1	59	w.	9.8

Fourth flight: Five kites were used; lifting surface, 32.0 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,400 m.

A few A.-St. were observed during the early part of the flight and 1/10 Ci-Cu. during the latter part. Their direction of movement was not determined. For a short while there were a few Cu. from the northwest.

Fifth flight: One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m. There was 1/10 Ci.-St., probably from the northwest, until 8 p. m.

At 8 p. m. pressure was low over Nova Scotia and the middle Mississippi Valley and high over North Dakota.

Sixth flight: Five kites were used; lifting surface, 33.5 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,600 m.

The sky was cloudless until about 1 a. m., when a few A.-Cu., from the northwest, appeared.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 17:											
First flight—	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.51 a. m....	713.8	24.0	57	w.	10.7	526	713.8	24.0	57	w.	10.7
2.03 a. m....	713.8	24.0	59	w.	10.7	1,076	670.2	21.4	61	wnw.	22.7
2.28 a. m....	713.7	23.5	61	w.	10.7	1,804	615.9	16.9	49	wnw.	13.3
2.45 a. m....	713.6	23.3	60	w.	11.2	2,302	580.7	12.8	49	wnw.	13.6
3.14 a. m....	713.5	23.3	59	w.	11.2	3,364	510.9	3.7	72	wnw.	22.4
3.45 a. m....	713.4	23.0	60	w.	11.6	2,415	572.4	12.7	49	wnw.	19.0
4.37 a. m....	713.6	22.8	61	wnw.	10.7	526	713.6	22.8	61	wnw.	10.7
Second flight—											
5.05 a. m....	713.7	22.0	65	wnw.	11.2	526	713.7	22.0	65	wnw.	11.2
5.11 a. m....	713.8	22.0	64	wnw.	11.6	1,024	674.2	21.5	60	wnw.	23.2
5.24 a. m....	713.8	21.8	65	wnw.	11.2	1,722	621.7	16.5	60	nw.	22.4
5.38 a. m....	713.9	21.4	67	wnw.	11.6	2,407	573.4	11.1	63	nw.	21.6
5.55 a. m....	714.0	22.1	63	wnw.	11.6	3,293	515.3	4.6	66	nw.	23.2
6.34 a. m....	714.2	21.7	67	w.	8.9	2,422	572.4	9.5	72	nw.	19.8
6.52 a. m....	714.4	22.1	63	w.	9.4	1,769	618.8	16.1	62	nw.	21.2
7.06 a. m....	714.4	22.1	63	w.	8.9	1,056	672.2	20.6	68	wnw.	21.2
7.15 a. m....	714.4	22.1	65	w.	8.9	526	714.4	22.1	65	w.	8.9
Third flight—											
7.51 a. m....	714.4	23.2	61	w.	9.8	526	714.4	23.2	61	w.	9.8
8.00 a. m....	714.4	23.0	61	w.	9.8	1,067	671.2	22.3	60	wnw.	20.8
8.15 a. m....	714.4	23.0	62	w.	8.5	1,655	627.6	18.4	50	wnw.	20.0
8.35 a. m....	714.5	22.8	63	w.	8.5	2,518	566.8	10.5	57	nw.	25.6
8.51 a. m....	714.5	22.7	65	w.	8.9	3,413	508.3	2.2	51	nw.	28.8
9.28 a. m....	714.5	23.3	63	w.	8.5	2,476	569.6	11.7	52	nw.	28.8
9.53 a. m....	714.4	24.3	62	w.	8.9	1,666	626.6	17.4	62	nw.	22.8
10.07 a. m....	714.3	25.3	58	w.	8.5	1,085	670.1	21.1	58	wnw.	16.0
10.17 a. m....	714.3	25.9	59	w.	8.0	526	714.3	25.9	59	w.	8.0
Aug. 18, 1911:											
6.45 a. m....	713.5	18.5	90	nw.	6.3	526	713.5	18.5	90	nw.	6.3
6.50 a. m....	713.5	18.5	91	nw.	6.3	815	690.1	20.7	57	wnw.	10.8
7.14 a. m....	713.5	19.2	85	wnw.	4.5	1,639	627.0	15.4	65	nw.	15.2
7.40 a. m....	713.4	19.3	84	w.	5.4	2,349	576.3	11.0	64	wnw.	12.3
8.20 a. m....	713.4	20.8	75	w.	6.3	3,228	518.0	2.4	90	wnw.	20.6
9.43 a. m....	713.5	21.8	73	w.	5.4	4,308	452.7	−4.5	85	w.	28.3
10.17 a. m....	713.5	21.8	76	w.	3.6	4,916	418.9	−9.6	96	w.	27.0
10.35 a. m....	713.4	21.9	76	w.	2.7	4,148	462.0	−4.6	100	w.	23.8
11.06 a. m....	713.4	22.5	74	w.	3.6	2,942	536.8	5.0	47	wnw.	18.4
11.29 a. m....	713.3	22.1	78	w.	5.4	2,407	572.6	10.9	40	wnw.	17.3
11.35 a. m....	713.2	22.2	78	w.	5.4	1,772	617.3	15.5	32	wnw.	13.6
11.48 a. m....	713.2	22.8	72	w.	6.3	1,280	653.7	19.2	32	wnw.	15.2
11.52 a. m....	713.1	23.0	72	w.	6.3	1,136	664.7	17.9	59	wnw.	11.8
12.02 p. m...	713.1	23.6	72	w.	5.4	877	685.0	20.3	71	w.	10.0
12.07 p. m...	713.1	23.8	70	wsw.	5.4	526	713.1	23.8	70	wsw.	5.4

August 17.—First flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,700 m.

There were from 4/10 to 8/10 A.—Cu. from the northwest.

Second flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m., at maximum altitude.

A.-Cu., from the northwest, diminished from 8/10 to 3/10. After 6.45 a. m. there were about 2/10 Ci.-St. from the west-northwest.

Third flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m., at maximum altitude.

There were 3/10 to 5/10 Ci.-St. from the west-northwest and 2/10 to 4/10 A.-Cu. from the northwest.

At 8 a. m. pressure was low over the Gulf of St. Lawrence and comparatively high over the Dakotas and the Gulf States.

August 18.—Six kites were used; lifting surface, 37. 8 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,300 m.

There were 9/10 St.-Cu. until 9 a. m. and 4/10 A.-Cu. and 5/10 St.-Cu., from the west, thereafter. Light rain fell from 10.20 to 10.40 a. m.

Pressure was low over New Brunswick and high over Minnesota and over Florida.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 19:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.40 a. m....	714.9	14.1	70	wnw.	8.0	526	714.9	14.1	70	wnw.	8.0
6.45 a. m....	714.9	14.1	70	wnw.	7.6	928	681.6	11.2	67	nw.	16.0
6.58 a. m....	714.9	14.4	69	wnw.	8.5	1,396	644.4	8.7	75	nw.	20.8
7.10 a. m....	714.9	14.4	70	wnw.	7.6	1,807	613.0	5.0	81	nw.	22.4
7.24 a. m....	714.9	14.5	70	wnw.	8.0	2,504	563.0	6.2	33	nw.	24.1
7.37 a. m....	714.9	14.6	73	wnw.	7.2	3,232	515.0	2.9	17	nw.	24.7
8.10 a. m....	715.0	15.3	70	wnw.	7.6	3,777	481.0	....	6	nw.	24.0
8.53 a. m....	715.3	16.6	62	wnw.	8.0	3,278	511.4	0.7	4	nw.	21.6
9.08 a. m....	715.3	16.9	61	wnw.	7.2	2,775	544.6	2.6	5	nw.	19.3
9.23 a. m....	715.3	17.1	60	nw.	6.7	2,175	586.4	2.4	31	nw.	21.7
9.30 a. m....	715.3	17.2	59	nw.	7.6	1,902	606.3	4.1	64	nw.	20.0
9.45 a. m....	715.3	17.6	56	nw.	7.6	1,201	660.3	8.7	75	nw.	20.8
9.52 a. m....	715.3	17.9	58	nw.	6.7	999	676.4	11.3	70	nw.	10.0
10.03 a. m....	715.3	17.7	56	nw.	7.2	526	715.3	17.7	56	nw.	7.2
Aug. 20:											
1.17 p. m....	716.5	20.6	47	se.	1.5	526	716.5	20.6	47	se.	1.5
1.38 p. m....	716.4	20.2	45	se.	1.7	2,233	585.3	5.2	......	w.	....
1.48 p. m....	716.3	21.2	47	sw.	1.4	1,786	617.7	10.0	......	calm.	....
2.05 p. m....	716.2	21.8	42	w.	1.4	952	681.7	17.0	......	calm.	....
2.10 p. m....	716.1	22.9	43	sse.	1.6	526	716.1	22.9	43	sse.	1.6
Aug. 21:											
1.18 p. m....	719.8	22.9	46	ese.	6.3	526	719.8	22.9	46	ese.	6.3
1.45 p. m....	719.8	22.9	47	ese.	4.7	2,524	568.1	5.9	......	calm.	....
1.58 p. m....	719.7	24.0	48	ese.	3.6	1,842	616.9	10.3	......	se.	....
2.11 p. m....	719.6	22.8	48	ese.	4.0	1.367	652.6	14.0	......	se.	....
2.18 p. m....	719.6	22.9	47	ne.	3.4	927	687.1	18.1	......	ese.	....
2.25 p. m....	719.6	23.6	47	e.	4.9	526	719.6	23.6	47	e.	4.9
Aug. 22:											
9.52 a. m....	720.1	21.4	54	se.	2.7	526	720.1	21.4	54	se.	2.7
10.02 a. m....	720.1	20.6	54	se.	3.6	1,966	607.8	11.4	......	ne.	....
10.25 a. m....	720.1	21.1	49	se.	3.6	1.454	646.0	13.7	......	n.	....
10.47 a. m....	720.2	21.4	47	se.	4.5	912	688.7	16.4	......	se.	....
10.50 a. m....	720.2	21.5	48	se.	4.5	526	720.2	21.5	48	se.	4.5

August 19.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 7,200 m., at maximum altitude.

The sky was cloudless.

Pressure was high over the upper Lakes and low over New Brunswick.

August 20.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 5/10 to 3/10 Cu., direction varying from west to west-southwest.

Pressure was high over Lake Michigan and low over the Georgia and South Carolina coast and over the Gulf of St. Lawrence.

August 21.—One captive balloon was used; capacity 22.4 cu. m. Wire out 2,200 m.

There were 2/10 Cu. from the southeast; altitude of cloud base about 2,100 m.

Pressure was high over the middle Atlantic States and southern New England and low over Manitoba.

August 22.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were a few Ci.-St. near the horizon.

Pressure was low over the Lake region and relatively low off the North Carolina coast. A ridge of high pressure extended from Georgia to Massachusetts.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 23:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.39 a. m....	719.6	20.6	57	w.	8.9	526	719.6	20.6	57	w.	8.9
6.50 a. m....	719.6	20.8	56	w.	9.8	807	696.9	23.1	45	wnw.	10.4
8.12 a. m....	719.7	22.4	53	w.	7.6	1,459	646.6	18.2	51	wnw.	8.4
9.33 a. m....	719.8	23.5	56	w.	5.8	1,107	673.5	21.6	45	wnw.	4.5
9.45 a. m....	719.8	23.7	52	w.	5.4	797	697.9	23.2	47	wnw.	8.0
9.49 a. m....	719.8	23.7	53	wnw.	4.9	526	719.8	23.7	53	wnw.	4.9
Aug. 24:											
3.08 p. m....	717.6	26.2	67	calm.	0.0	526	717.6	26.2	67	calm.	0.0
3.16 p. m....	717.6	25.4	71	nw.	2.7	1,993	605.3	14.0	......	s.	....
3.36 p. m....	717.5	24.1	76	e.	2.7	1,110	671.0	18.1	......	s.	....
3.50 p. m....	717.5	24.1	79	calm.	0.0	894	688.1	20.9	......	s.	....
3.56 p. m....	717.5	24.5	70	calm.	0.0	526	717.5	24.5	70	calm.	0.0
Aug. 25:											
1.36 p. m....	716.4	24.1	......	se.	3.6	526	716.4	24.1	......	se.	3.6
1.48 p. m....	716.4	24.4	73	se.	3.6	1,919	609.3	13.8	......	wsw.	....
1.59 p. m....	716.3	24.6	......	se.	3.6	1,238	659.9	17.8	......	sw.	....
2.10 p. m....	716.0	25.0	......	sse.	3.5	822	692.3	21.2	......	ssw.	....
2.15 p. m....	715.9	24.8	......	sse.	3.4	526	715.9	24.8	......	sse.	3.4
Aug. 26:											
10.03 a. m....	719.3	21.0	96	se.	0.9	526	719.3	21.0	96	se.	0.9
10.24 a. m....	719.3	21.5	94	s.	0.9	2,137	596.1	13.7	......	sw.	....
10.34 a. m....	719.3	21.8	92	se.	0.9	1,862	615.7	17.3	......	wsw.	....
10.48 a. m....	719.3	21.7	91.	ne.	0.9	1,514	641.2	16.4	......	calm.	....
11.00 a. m....	719.3	21.6	94	ne.	0.9	892	689.5	18.1	......	calm.	....
11.06 a. m....	719.3	21.6	94	ne.	0.9	686	706.2	19.7	......	n.	....
11.09 a. m....	719.3	21.5	94	nne.	0.9	526	719.3	21.5	94	nne.	0.9

August 23. Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 3,400 m.; at maximum altitude, 2,700 m.

There were 2/10 to a few St.-Cu. from the west, changing to A.-Cu. from the same direction.

Pressure was low over the Gulf of St. Lawrence and high over South Dakota and off the Carolina coast.

August 24.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

The sky was covered with Cu. and St.-Cu. from the west-southwest, and Nb. from the south. Distant thunder was heard in the west-southwest at 3.13 p. m. Rain fell from 3.22 to 3.55 p. m.

Pressure was high over the Lake region and off the Carolina coast, and was relatively low over northern Virginia and the lower Mississippi Valley.

August 25.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,800 m.

There were 7/10 to 4/10 St.-Cu. from the west-southwest.

Low pressure was central over North Dakota and pressure was high over the west central Plains. Pressure was relatively low over the Ohio valley, with a secondary depression off the New Jersey coast.

August 26.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,200 m.

There were 10/10 St. from the southeast, changing to north; cloud altitude, 1,000 to 700 m.

Pressure was high over Lake Erie and low over Nebraska, with a slight depression over Virginia.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 27:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.56 p. m....	718.6	25.2	77	sse.	5.8	526	718.6	25.2	77	sse.	5.8
2.10 p. m....	718.5	25.5	75	se.	5.4	804	696.1	21.7	81	sse.	9.3
2.31 p. m....	718.4	26.1	73	sse.	5.8	1,203	664.7	18.3	89	sse.	9.6
3.05 p. m....	718.2	25.8	70	se.	8.0	1,489	642.8	18.3	59	s.	9.5
3.29 p. m....	718.2	26.2	74	ese.	7.2	2,112	597.4	12.1	68	ssw.	8.6
4.06 p. m....	718.1	26.0	72	se.	4.9	3,075	532.0	6.3	70	s.	13.2
4.20 p. m....	718.1	26.3	72	se.	4.5	2,525	568.4	8.6	76	s.	8.1
4.34 p. m....	718.1	26.3	72	se.	4.5	1,858	615.6	14.5	67	s.	10.5
4.45 p. m....	718.1	26.4	73	se.	5.4	1,189	665.7	18.6	90	se.	6.7
4.52 p. m....	718.1	26.4	73	se.	5.8	813	695.1	22.6	83	se.	6.8
4.57 p. m....	718.1	26.4	72	se.	5.8	526	718.1	26.4	72	se.	5.8
Aug. 28:											
9.59 a. m....	717.7	24.2	88	s.	8.0	526	717.7	24.2	88	s.	8.0
10.10 a. m....	717.7	24.0	88	s.	6.7	875	689.6	19.6	93	ssw.	16.4
10.22 a. m....	717.7	23.9	86	s.	8.5	1,364	651.4	17.5	87	ssw.	18.4
10.38 a. m....	717.6	24.6	83	sw.	8.0	2,228	588.6	12.5	67	ssw.	23.3
10.51 a. m....	717.6	24.8	82	ssw.	7.2	2,939	540.7	9.5	63	ssw.	21.6
11.18 a. m....	717.4	25.2	80	ssw.	7.6	3,411	510.5	4.9	61	ssw.	25.2
11.47 a. m....	717.1	25.7	77	ssw.	7.6	3,974	476.2	1.0	56	ssw.	24.6
12.24 p. m....	716.9	25.7	77	s.	7.2	3,462	507.1	4.4	60	ssw.	25.6
12.41 p. m....	716.8	26.2	75	sse.	8.5	2,978	538.0	7.9	83	ssw.	24.8
1.06 p. m....	716.7	26.5	71	s.	8.5	2,334	581.1	12.0	78	ssw.	22.0
1.22 p. m....	716.6	26.4	71	ssw.	8.5	1,453	644.4	18.4	75	ssw.	20.4
1.39 p. m....	716.4	26.5	71	ssw.	8.5	887	687.6	22.3	82	ssw.	17.2
1.50 p. m....	716.4	26.8	71	s.	7.2	526	716.4	26.8	71	s.	7.2
Aug. 29:											
2.09 p. m....	717.3	19.0	98	nnw.	6.7	526	717.3	19.0	98	nnw.	6.7
2.15 p. m....	717.3	18.9	98	nnw.	8.5	872	688.9	16.5	95	n.	10.3
3.24 p. m....	717.9	17.0	100	nnw.	9.8	1,172	665.6	15.6	89	nne.	9.1
3.34 p. m....	718.2	17.0	100	nnw.	8.0	1,549	636.8	14.0	92	nne.	6.0
4.09 p. m....	718.3	15.8	100	nnw.	10.3	880	688.9	15.9	81	nne.	14.0
4.13 p. m....	718.3	15.7	100	nnw.	10.7	618	710.5	13.5	84	n.	12.7
4.18 p. m....	718.3	15.5	100	nnw.	9.8	526	718.3	15.5	100	nnw.	9.8

August 27.—Five kites were used; lifting surface, 37.4 sq. m. Wire out, 4,400 m.; at maximum altitude, 3,300 m.

There were 1/10 to 4/10 A.-Cu. from the south-southwest and 5/10 to 1/10 Cu. from the south-southwest and south.

Pressure was low over Lake Superior and the Carolina coast and high off the New England coast.

August 28.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 8,000 m.; at maximum altitude, 7,400 m.

Ci., from the west-southwest, increased from few to 5/10; St.-Cu., from the south-southwest, decreased from 7/10 to 1/10; altitude of St.-Cu., 800 m.

Pressure was high over the Dakotas and south of Newfoundland and relatively low north of the lower Lakes. A severe tropical cyclone was central over South Carolina and Florida.

August 29.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 4,000 m.; at maximum altitude, 3,900 m.

There was dense fog throughout the flight and light rain after 3.35 p. m.

Low pressure was central over Georgia and over the lower St. Lawrence. High pressure was central over Wisconsin and east of the Carolinas.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Aug. 30:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
5.11 p. m....	720.0	12.9	100	ne.	5.8	526	720.0	12.9	100	ne.	5.8
5.16 p. m....	719.9	12.9	100	ne.	5.4	752	700.8	11.6	......	ene.	....
5.38 p. m....	719.9	12.9	100	ne.	5.4	526	719.9	12.9	100	ne.	5.4
Aug. 31:											
3.27 p. m...	715.7	13.0	100	nnw.	8.9	526	715.7	13.0	100	nnw.	8.9
3.44 p. m...	715.7	13.0	100	nnw.	8.0	886	685.8	11.7	100	nnw.	12.6
4.03 p. m...	715.7	13.0	100	nnw.	7.2	1,165	663.5	14.9	95	nnw.	6.3
4.09 p. m...	715.7	13.0	100	nnw.	7.2	898	684.8	11.3	100	nnw.	12.8
4.17 p. m...	715.7	13.0	100	nnw.	6.7	526	715.7	13.0	100	nnw.	6.7
Sept. 1:											
4.02 p. m...	719.1	23.1	74	sse.	4.0	526	719.1	23.1	74	sse.	4.0
4.12 p. m...	719.1	24.2	71	s.	4.5	2,116	597.7	14.0	......	nw.	....
4.24 p. m...	719.1	24.0	71	s.	4.5	1,456	645.9	16.6	......	wnw.	....
4.32 p. m...	719.1	24.1	69	s.	4.2	1,353	653.7	17.3	......	w.	....
4.45 p. m...	719.1	23.7	73	s.	4.0	889	689.8	21.0	......	sw.	....
4.52 p. m...	719.1	23.7	71	s.	4.6	526	719.1	23.7	71	s.	4.6
Sept. 2:											
9.18 a. m....	719.6	23.8	77	se.	3.1	526	719.6	23.8	77	se.	3.1
9.27 a. m....	719.4	24.1	76	se.	3.6	1,319	656.6	17.6	......	wsw.	....
9.31 a. m....	719.3	24.0	76	se.	4.0	832	694.5	21.8	......	wsw.	....
10.48 a. m....	719.0	25.0	76	se.	4.5	526	719.0	25.0	76	se.	4.5
Sept. 3:											
6.13 a. m....	716.3	20.7	76	w.	11.6	526	716.3	20.7	76	w.	11.6
6.15 a. m....	716.4	20.7	76	w.	11.6	766	697.0	23.4	62	w.	17.7
6.23 a. m....	716.4	20.9	74	w.	11.6	986	679.7	21.3	66	wnw.	17.2
6.38 a. m....	716.4	20.6	78	w.	9.8	1,495	640.8	17.5	69	nw.	14.7
6.47 a. m....	716.5	20.7	77	w.	10.7	1,786	619.5	15.9	69	nw.	10.8
7.37 a. m....	716.5	21.7	74	w.	8.0	2,608	562.1	10.1	73	nw.	9.2
8.23 a. m....	716.6	22.0	76	w.	8.5	3,784	486.8	0.2	64	wnw.	14.3
8.39 a. m....	716.6	22.1	79	w.	7.2	3,353	513.5	4.6	60	wnw.	8.7
8.52 a. m....	716.7	22.0	80	wnw.	6.7	2,773	551.0	9.3	68	wnw.	11.6
9.10 a. m....	716.7	22.6	78	wnw.	6.3	2,336	580.5	13.2	47	nw.	12.7
9.20 a. m....	716.8	22.7	77	wnw.	6.3	2,094	597.4	12.9	77	nw.	12.9
9.38 a. m....	716.8	23.1	74	wnw.	5.8	1,392	648.7	18.7	74	nw.	10.1
9.52 a. m....	716.9	23.4	74	wnw.	5.4	913	685.8	20.3	68	wnw.	9.6
10.02 a. m....	716.9	23.8	74	wnw.	4.9	526	716.9	23.8	74	wnw.	4.9

August 30.—One captive balloon was used, capacity, 22.4 cu. m. Wire out, 1,500 m. There were 10/10 Nb. from the northeast. Light rain fell during the entire day. Pressure was high over Ontario and low over Georgia.

August 31.—Two kites were used; lifting surface, 14.6 sq. m. Wire out, 1,500 m.; at maximum altitude, 1,000 m.

There were light rain and dense fog.

Pressure was high over Arkansas and New Brunswick and low over Virginia and the Carolinas.

September 1.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,500 m.

1/10 Cu. from the west-southwest had disappeared before the end of the flight. There was light haze.

An extensive high was central over southwestern Virginia and eastern Kentucky and low pressure was central south of Nova Scotia.

September 2.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,200 m.

The sky was cloudless.

Pressure was low over the upper Lakes and high off the South Atlantic States.

September 3.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 6,500 m.; at maximum altitude, 5,300 m.

The sky was 3/10 to 6/10 covered with Ci. and A.-Cu. from the west-northwest.

Pressure was high over the upper Lakes and low over the Gulf of St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 4:	*mm.*	° *C.*	%		*m.p.s.*	*m.*	*mm.*	° *C.*	%		*m.p.s.*
8.19 a. m....	722.1	16.5	61	ene.	5.4	526	722.1	16.5	61	ene.	5.4
8.29 a. m....	722.1	16.7	61	ene.	5.1	860	694.3	13.7	62	e.	8.6
8.49 a. m....	722.2	16.6	60	ene.	5.6	1,048	679.1	12.6	68	ese.	6.7
9.07 a. m....	722.2	16.4	65	e.	5.1	1,147	671.1	11.2	70	ese.	6.6
9.49 a. m....	722.1	16.8	69	e.	4.2	1,208	666.1	11.3	70	ese.	6.6
9.52 a. m....	722.1	16.6	67	e.	4.2	1,131	672.1	11.9	70	ese.	6.9
9.55 a. m....	722.1	16.2	65	e.	5.1	785	700.4	13.4	64	e.	6.8
9.58 a. m....	722.1	16.4	64	e.	5.1	650	711.6	14.6	64	e.	6.8
10.02 a. m....	722.1	16.6	63	e.	5.4	526	722.1	16.6	63	e.	5.4
Sept. 5:											
6.48 a. m....	719.4	16.0	89	se.	6.3	526	719.4	16.0	89	se.	6.3
6.55 a. m....	719.4	16.0	89	se.	7.2	949	684.0	15.4	90	s.	13.6
7.37 a. m....	719.4	16.5	93	sse.	7.2	1,208	663.7	17.0	80	ssw.	7.5
9.03 a. m....	719.1	18.7	84	se.	7.6	1,567	636.8	14.4	85	ssw.	5.9
9.17 a. m....	719.1	19.0	84	se.	9.8	1,182	665.8	18.2	74	s.	8.4
9.30 a. m....	719.1	19.6	74	se.	9.8	978	682.0	17.2	74	s.	15.2
9.43 a. m....	719.1	20.1	72	se.	10.7	526	719.1	20.1	72	se.	10.7
Sept. 6:											
6.23 a. m....	712.8	18.6	98	wnw.	9.4	526	712.8	18.6	98	wnw.	9.4
6.30 a. m....	712.8	18.5	99	wnw.	9.4	861	685.6	17.8	84	wnw.	14.8
6.44 a. m....	713.0	18.6	98	wnw.	9.8	1,287	652.3	15.1	86	nw.	17.6
7.00 a. m....	713.1	18.9	96	wnw.	8.0	1,918	605.4	10.4	96	nw.	20.4
7.03 a. m....	713.1	18.9	96	wnw.	7.2	2,065	594.9	12.5	72	nw.	20.4
7.18 a. m....	713.2	19.1	95	wnw.	6.7	2,433	569.6	10.6	64	nw.	18.4
7.49 a. m....	713.3	19.5	94	wnw.	6.7	2,900	538.4	7.9	61	wnw	11.7
8.27 a. m....	713.6	20.8	87	wnw.	7.2	3,593	495.0	1.8	52	wnw.	14.9
9.48 a. m....	714.0	22.2	75	wnw.	8.0	3,797	483.0	−0.7	81	wnw.	22.5
9.51 a. m....	714.1	22.3	74	wnw.	8.0	3,852	479.5	−0.2	66	wnw.	22.5
9.54 a. m....	714.1	22.4	74	wnw.	7.6	3,798	483.0	−0.7	89	wnw.	22.5
10.06 a. m....	714.1	22.4	74	wnw.	6.3	3,643	492.4	1.9	52	wnw.	22.1
10.25 a. m....	714.1	22.7	73	wnw.	6.3	2,876	541.0	6.9	43	wnw.	17.7
10.49 a. m....	714.2	22.7	74	wnw.	8.9	2,370	575.1	10.3	44	nw.	17.7
11.05 a. m....	714.2	23.3	70	wnw.	6.7	1,766	617.9	14.3	54	nw.	14.6
11.09 a. m....	714.2	23.8	68	wnw.	6.7	1,504	637.4	13.5	82	nw.	11.0
11.15 a. m....	714.2	23.0	68	wnw.	8.0	1,190	661.3	15.9	81	wnw.	11.2
11.29 a. m....	714.2	24.0	67	wnw.	8.9	920	682.6	18.9	76	wnw.	10.4
11.38 a. m....	714.2	23.8	67	wnw.	8.5	526	714.2	23.8	67	wnw.	8.5

September 4.—Four kites were used; lifting surface, 35.5 sq. m. Wire out, 2,100 m.; at maximum altitude, 1,300 m.

There were 3/10 St. and A.-St. and 5/10 Ci. from the west at the beginning of the flight and 8/10 Ci.-Cu. and A.-St. from the west at the close of the flight.

Pressure was high over the lower Lake region and low over the upper Missouri Valley.

September 5.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 5,300 m.; at maximum altitude, 2,125 m.

The sky was about 7/10 overcast, with A.-Cu. from the west, and St.-Cu. from the south.

Low pressure was central over Minnesota. Pressure was high off the New England coast.

September. 6.—Eight kites were used; lifting surface, 50.4 sq. m. Wire out, 8,800 m.; at maximum altitude, 5,900 m.

At the beginning of the flight there were a few St. from the west-northwest, altitude 800 m., and 10/10 St.-Cu. from the northwest, altitude, 2,000 m. These had dissipated by 7.30 a. m., revealing A.-Cu. from the west-northwest, which diminished from 7/10 to none by 8.15 a. m. Thereafter there were few to 2/10 Ci.-St. from the west and 4/10 to 5/10 Cu. from the northwest; altitude of Cu., 1,300 m.

Pressure was low over the middle St. Lawrence Valley and relatively high off the Middle Atlantic States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 7:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.33 p. m...	717.8	27.6	64	s.	4.9	526	717.8	27.6	64	s.	4.9
1.43 p. m...	717.8	28.1	64	s.	4.4	1,698	627.2	16.9	......	ssw.	....
1.46 p. m...	717.8	28.4	63	s.	4.4	1,241	661.5	18.7	......	wsw.	....
1.50 p. m...	717.8	28.1	63	s.	3.5	1,067	675.0	20.4	......	wsw.	....
2.05 p. m...	717.8	27.4	64	s.	3.6	969	682.6	21.5	......	s.	....
2.22 p. m...	717.8	28.1	61	s.	3.5	526	717.8	28.1	61	s.	3.5
Sept. 8:											
1.30 p. m...	722.1	24.2	79	se.	7.2	526	722.1	24.2	79	se.	7.2
1.55 p. m...	722.0	24.2	78	se.	7.6	1,038	680.0	19.5	90	sse.	8.5
3.20 p. m...	721.7	24.8	78	se.	7.6	1,295	660.7	18.8	84	sse.	6.6
3.37 p. m...	721.6	24.7	80	ese.	8.5	1,708	629.3	14.1	99	sse.	6.4
3.51 p. m...	721.5	24.4	81	ese.	8.9	1,201	667.7	19.5	80	sse.	10.3
4.03 p. m...	721.5	23.8	83	se.	7.6	916	689.9	19.8	96	se.	12.0
4.08 p. m...	721.5	23.6	85	ese.	7.6	526	721.5	23.6	85	ese.	7.6
Sept. 9:											
4.15 p. m...	721.1	20.8	96	se.	2.2	526	721.1	20.8	96	se.	2.2
4.32 p. m...	721.1	20.8	96	se.	1.8	1,875	616.0	13.5	......	wsw.	....
4.46 p. m...	721.1	20.9	96	ese.	1.8	1,603	636.0	15.0	......	w.	....
4.56 p. m...	721.1	20.8	96	se.	2.2	1,077	676.4	17.2	......	w.	....
5.06 p. m...	721.1	20.8	96	se.	2.2	526	721.1	20.8	96	se.	2.2
Sept. 10:											
10.28 a. m....	719.2	20.5	91	nw.	4.5	526	719.2	20.5	91	nw.	4.5
10.48 a. m....	719.1	20.7	90	nw.	4.5	1,934	610.3	13.1	......	nw.	....
10.58 a. m....	719.1	21.4	86	nw.	4.0	1,686	628.4	14.5	......	nnw.	....
11.08 a. m....	719.1	21.5	87	nw.	4.0	1,233	662.7	17.4	......	nnw.	....
11.20 a. m....	719.0	21.6	87	wnw.	4.5	890	689.5	20.2	......	nnw.	....
11.25 a. m....	719.0	22.1	87	w.	4.5	526	719.0	22.1	87	w.	4.5

September 7.—One captive balloon was used: capacity, 22.4 cu. m. Wire out, 2,200 m. There were 2/10 to 3/10 Cu. from the south and from 1/10 to 3/10 Ci.-St. from the north and northwest. 1/10 A.-St. at the beginning of the flight, disappeared shortly afterwards.

Pressure was high over the South Atlantic States and low over Illinois.

September 8.—Five kites were used; lifting surface, 37.4 sq. m. Wire out, 3,600 m.; at maximum altitude, 2,000 m.

At the beginning there were a few A.-Cu. from the west. St.-Cu. from the south-southeast increased from 4/10 to 7/10. The head kite was in St.-Cu. at intervals from 3.27 to 4 p. m.; altitude of St.-Cu. base, about 1,000 m.

Pressure was high over the eastern United States, with centers over Ontario and New England.

September 9.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 10/10 St.-Cu. from the west-southwest; altitude, 1,900 m. Light rain fell after 4.57 p. m.

Pressure was high off Nova Scotia and over the upper Lakes and relatively low from the lower Lakes to the West Gulf States.

September 10.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,900 m.

There were 3/10 St. from the northwest. The base of the clouds was about 50 meters above the ground.

Pressure was relatively low over the Gulf of St. Lawrence and relatively high over eastern Tennessee.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 11:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.29 p. m...	713.2	22.2	76	calm.	0.0	526	713.2	22.2	76	calm.	0.0
2.03 p. m...	713.0	22.1	74	wnw.	2.7	2,198	586.3	13.5	......	calm.	....
2.13 p. m...	712.9	22.8	78	ne.	2.2	1,966	602.4	16.1	......	calm.	....
2.23 p. m...	712.8	23.1	79	ene.	2.2	1,365	646.6	14.2	......	n.	....
2.41 p. m...	712.7	23.0	77	ese.	1.8	989	675.7	17.2	......	calm.	....
2.53 p. m...	712.6	21.9	81	ese.	1.8	526	712.6	21.9	81	ese.	1.8
Sept. 12:											
First flight—											
6.37 a. m....	710.7	19.0	85	wnw.	13.0	526	710.7	19.0	85	wnw.	13.0
6.41 a. m....	710.7	18.8	86	wnw.	12.5	881	682.0	18.1	81	wnw.	20.0
6.56 a. m....	710.7	19.0	85	wnw.	11.2	1,482	635.8	16.0	59	wnw.	22.3
7.08 a. m....	710.7	19.4	84	wnw.	11.6	2,113	590.3	13.9	35	nw.	20.0
7.24 a. m....	710.7	20.2	79	wnw.	10.7	3,140	522.0	6.8	35	nw.	20.0
7.33 a. m....	710.7	20.6	75	wnw.	10.7	3,241	515.7	3.6	41	wnw.	21.7
7.50 a. m....	710.7	19.9	80	wnw.	9.4	4,087	463.8	− 4.5	69	wnw.	24.0
8.13 a. m....	710.8	19.8	81	wnw.	11.2	4,671	430.9	− 8.0	73	wnw.	24.8
8.43 a. m....	711.0	20.6	81	wnw.	9.4	4,968	414.9	....	27	nw.	....
10.17 a. m....	711.3	22.9	67	wnw.	9.8	2,660	552.0	4.3	80	wnw.	23.0
10.30 a. m....	711.2	23.0	67	wnw.	11.2	2,482	564.0	5.6	85	nw.	23.7
10.40 a. m....	711.2	23.1	69	wnw.	9.4	1,998	597.9	7.9	96	nw.	18.1
10.50 a. m....	711.2	22.8	67	wnw.	7.6	1,604	627.0	11.5	79	nw.	15.3
11.05 a. m....	711.2	22.7	63	nw.	9.8	901	681.0	18.3	73	nw.	13.2
11.12 a. m....	711.2	22.8	65	wnw.	8.9	526	711.2	22.8	65	wnw.	8.9
Second flight—											
11.46 a. m....	711.2	22.9	65	wnw.	7.6	526	711.2	22.9	65	wnw.	7.6
11.58 a. m....	711.2	22.8	62	wnw.	7.6	883	682.5	18.3	72	nw.	11.3
12.05 p. m...	711.2	22.6	64	wnw.	9.8	1,584	628.5	11.8	89	wnw.	21.5
12.19 p. m...	711.2	22.9	65	wnw.	8.9	2,495	563.0	4.6	81	wnw.	24.4
12.42 p. m...	711.3	23.2	61	wnw.	10.3	2,917	534.7	2.1	72	wnw.	27.7
12.47 p. m...	711.3	23.2	61	wnw.	8.9	3,016	528.4	3.0	47	wnw.	27.7
12.53 p. m...	711.3	23.3	63	wnw.	10.3	2,935	533.8	1.9	70	wnw.	27.7
1.03 p. m...	711.3	23.7	61	wnw.	8.9	2,638	553.7	4.0	80	wnw.	25.6
1.31 p. m...	711.4	22.7	66	wnw.	8.9	1,576	629.5	12.2	87	wnw.	18.8
1.43 p. m...	711.4	23.5	67	nw.	10.3	887	682.5	18.8	73	nw.	15.2
1.57 p. m...	711.4	23.3	62	wnw.	10.7	526	711.4	23.3	62	wnw.	10.7

September 11.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,160 m.

A.-Cu. from the west, and Cu. from the north, diminished from 6/10 to 2/10. The balloon was in or above Cu. at intervals from 1.34 to 2.38 p. m.; altitude of base of lowest Cu. was about 9.15 m.

Pressure was low over southern Canada and was relatively high over the Gulf coast and eastward thereof. A slight depression lay over Virginia and Maryland.

September 12.—First flight: Six kites were used; lifting surface, 37.8 sq. m. Wire out, 10,000 m.; at maximum altitude, 8,900 m.

1/10 Ci.-St. and 1/10 St. from the west-northwest at the beginning soon disappeared. Later there were 4/10 to 5/10 A.-Cu. from the west-northwest and 2/10 to 7/10 A.-St. from the west-northwest. There were 3/10 Cu. from the northwest at an altitude of 1,875 m. from about 10.30 a. m. to the end of the flight.

At 8 a. m. high pressure was central over northern Minnesota and Wisconsin and over the middle Gulf States and a well developed low was central over the lower St. Lawrence Valley.

Second flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 4,800 m.; at maximum altitude, 3,700 m.

There were 2/10 to 6/10 Cu. from the west-northwest at an altitude of 1,800 m.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 12:											
Third flight—	*mm.*	°*C.*	%		*m. p. s.*	*m.*	*mm.*	°*C.*	%		*m. p. s.*
2.31 p. m.	711.3	22.8	65	wnw.	12.1	526	711.3	22.8	65	wnw.	12.1
2.39 p. m.	711.3	22.7	65	wnw.	11.6	860	684.5	18.9	73	wnw.	17.2
2.47 p. m.	711.3	23.1	62	wnw.	13.4	1,286	651.2	15.5	64	wnw.	20.4
3.05 p. m.	711.3	22.8	61	wnw.	15.2	2,021	596.8	9.4	46	wnw.	21.4
3.23 p. m.	711.4	22.5	61	wnw.	10.7	2,529	561.2	4.5	67	wnw.	21.6
3.25 p. m.	711.4	22.5	60	wnw.	10.7	2,692	550.1	5.2	50	wnw.	28.0
3.40 p. m.	711.4	22.5	55	wnw.	11.6	3,080	524.1	2.3	42	wnw.	27.1
3.51 p. m.	711.5	22.3	56	wnw.	10.3	2,737	546.5	5.3	36	wnw.	27.1
4.07 p. m.	711.5	22.1	58	wnw.	11.2	2,385	570.5	5.0	60	wnw.	21.5
4.17 p. m.	711.5	21.9	60	wnw.	10.7	2,070	592.9	7.5	63	wnw.	20.8
4.53 p. m.	711.6	21.5	60	wnw.	8.5	1,261	653.2	14.0	76	nw.	18.4
5.09 p. m.	711.6	21.2	55	wnw.	10.7	926	679.4	17.9	61	nw.	18.4
5.17 p. m.	711.7	21.3	53	wnw.	9.8	526	711.7	21.3	53	wnw.	9.8
Fourth flight—											
5.44 p. m.	711.9	20.4	54	nw.	8.9	526	711.9	20.4	54	nw.	8.9
5.53 p. m.	712.0	20.2	53	nw.	9.4	1,072	668.3	17.8	48	nw.	16.8
6.14 p. m.	712.2	19.4	52	nw.	10.3	1,703	620.5	11.2	56	nw.	17.6
6.48 p. m.	712.5	18.7	54	nw.	10.7	2,712	549.5	5.6	11	nw.	20.3
7.10 p. m.	712.8	18.3	57	nw.	10.3	3,841	477.6	− 1.4	8	nw.	22.4
7.48 p. m.	713.1	18.0	57	nw.	11.2	2,718	548.6	4.9	7	nw.	17.9
8.03 p. m.	713.2	17.5	56	nw.	9.4	2,114	590.6	9.0	8	nw.	17.9
8.12 p. m.	713.3	17.4	54	nw.	11.2	1,717	619.5	9.6	11	nw.	17.1
8.17 p. m.	713.4	17.4	53	nw.	8.9	1,663	623.5	9.3	17	nw.	18.7
8.31 p. m.	713.5	17.3	52	nw.	10.7	1,019	673.4	13.9	59	nw.	17.1
8.38 p. m.	713.7	17.1	54	nw.	10.7	526	713.7	17.1	54	nw.	10.7
Fifth flight—											
8.57 p. m.	713.8	16.8	56	nw.	10.7	526	713.8	16.8	56	nw.	10.7
9.10 p. m.	713.8	16.5	57	nw.	10.3	1,021	673.4	13.6	61	nw.	16.8
9.20 p. m.	713.9	16.4	57	nw.	10.7	1,330	649.2	10.6	62	nw.	18.1
9.23 p. m.	713.9	16.3	57	nw.	9.8	1,445	640.3	11.9	32	nw.	17.3
9.29 p. m.	713.9	16.2	58	nw.	10.3	1,604	628.3	11.5	21	nw.	17.3
9.55 p. m.	714.0	16.0	58	nw.	12.1	2,690	551.3	6.3	13	nw.	20.8
10.19 p. m.	714.2	16.0	57	wnw.	12.5	3,807	480.1	−1.6	9	nw.	23.0
10.52 p. m.	714.6	15.2	59	wnw.	10.7	2,719	548.6	5.0	8	nw.	23.2
11.15 p. m.	714.8	14.5	64	wnw.	7.6	1,824	611.8	8.3	9	nw.	16.0
11.21 p. m.	714.8	14.4	63	wnw.	7.2	1,564	631.3	9.0	10	nw.	15.4
11.22 p. m.	714.8	14.4	62	nw.	7.2	1,447	640.3	6.9	18	nw.	15.4
11.33 p. m.	714.8	14.3	61	nw.	8.9	990	676.5	10.5	65	nw.	16.0
11.41 p. m.	714.8	14.0	64	wnw.	8.0	526	714.8	14.0	64	wnw.	8.0

Third flight: Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,800 m.

There were few to 2/10 Cu. from the west-northwest.

Fourth flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude.

At the beginning there were a few Cu. from the northwest. From 6.30 to about 8.30 p. m. a bank of clouds lay on the southeast horizon, with sheet lightning at intervals. There was light haze.

At 8 p. m. low pressure was central over New Brunswick, high pressure over Lake Superior.

Fifth flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,900 m.

There were no clouds.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept 13:											
First flight—	*mm.*	°*C.*	%		*m.p.s.*	*m.*	*mm.*	°*C.*	%		*m.p.s.*
12.22 a. m....	714.9	13.3	68	wnw.	11.6	526	714.9	13.3	68	wnw.	11.6
12.40 a. m....	715.0	13.1	68	nw.	8.9	1,120	666.0	9.0	76	nw.	15.8
12.50 a. m....	715.0	13.0	69	nw.	8.9	1,558	632.0	11.2	30	nw.	16.0
1.13 a. m....	715.0	12.8	69	nw.	13.4	2,168	587.5	10.6	16	nw.	19.9
1.28 a. m....	715.1	12.7	69	nw.	10.7	2,684	552.0	7.1	13	nw.	20.6
1.55 a. m....	715.2	12.3	71	nw.	9.8	3,621	492.0	1.3	10	nw.	20.4
2.17 a. m....	715.3	11.6	76	wnw.	10.3	2,816	542.8	5.8	8	nw.	19.2
2.33 a. m....	715.5	11.1	79	wnw.	8.9	1,923	604.8	10.1	9	nw.	16.0
2.45 a. m....	715.6	10.8	82	nw.	6.3	1,402	643.9	9.4	......	nw.	16.0
2.49 a. m....	715.6	10.7	82	nw.	5.4	1,098	668.0	7.2	......	nw.	14.4
2.57 a. m....	715.7	10.5	83	nw.	5.4	526	715.7	10.5	83	nw.	5.4
Second flight—											
3.20 a. m....	715.7	10.4	84	nw.	8.0	526	715.7	10.4	84	nw.	8.0
3.38 a. m....	715.7	9.9	85	nw.	8.0	998	676.2	7.9	79	nw.	15.2
3.53 a. m....	715.7	9.8	86	nw.	8.0	1,391	644.9	9.5	30	nw.	14.0
4.05 a. m....	715.7	9.5	87	nw.	8.9	1,806	613.5	9.4	24	nw.	16.6
4.22 a. m....	715.8	9.5	83	nw.	7.2	2,789	544.6	5.7	17	nw.	21.7
4.47 a. m....	716.0	9.4	87	nw.	8.9	3,770	482.5	−1.1	19	nw.	23.3
5.15 a. m....	716.2	9.1	89	nw.	8.0	2,785	544.6	5.0	18	nw.	20.0
5.31 a. m....	716.3	8.8	91	nw.	8.0	1,856	609.6	8.5	17	nw.	16.0
5.48 a. m....	716.4	8.7	92	wnw.	7.6	1,052	672.1	6.2	......	nw.	12.8
6.01 a. m....	716.5	8.6	93	nw.	8.0	526	716.5	8.6	93	nw.	8.0
Third flight—											
6.35 a. m....	717.0	8.8	88	nw.	6.7	526	717.0	8.8	88	nw.	6.7
6.47 a. m....	717.3	8.8	88	nw.	7.6	932	682.8	5.7	91	nnw.	12.0
7.06 a. m....	717.4	8.7	90	nw.	7.6	1,685	623.3	9.0	33	nw.	16.8
7.21 a. m....	717.6	8.8	91	nw.	7.6	2,663	553.7	4.3	26	nw.	20.0
7.42 a. m....	717.8	9.0	90	nw.	7.6	3,453	502.0	−1.9	56	nw.	24.0
8.10 a. m....	718.1	9.0	91	nw.	8.0	2,668	553.7	....	32	nw.	20.8
8.27 a. m....	718.3	9.2	90	nw.	5.8	1,800	615.6	....	29	nw.	20.0
8.41 a. m....	718.5	9.4	90	nw.	4.9	1,044	674.8	5.0	97	nnw.	11.6
8.55 a. m....	718.7	9.4	90	nw.	2.7	526	718.7	9.4	90	nw.	2.7

September 13.—First flight: Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,650 m.

There were a few A.-Cu. from the northwest which became A.-St. during the latter part of the flight. A few Ci. from the northwest were observed at 1.25 a. m.

Second flight: Four kites were used; lifting surface, 27.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,850 m.

A.-St. and A.-Cu. from the northwest increased from 1/10 to 8/10.

Third flight: Four kites were used; lifting surface, 27.2 sq. m. Wire out, 5,000 m.; at maximum altitude.

The sky was covered with A.-St. from the northwest. About 8 a. m. St. from the north-northwest appeared, increasing to 6/10 by 9 a. m.; altitude of St., 1,200 m.

At 8 a. m. pressure was high over the upper Lakes and low over Newfoundland.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 13:											
Fourth flight—	*mm.*	*° C.*	*%*		*m. p. s.*	*m.*	*mm.*	*° C.*	*%*		*m. p. s.*
9.51 a. m....	718.4	9.8	86	nnw.	6.3	526	718.4	9.8	86	nnw.	6.3
9.58 a. m....	718.4	9.8	84	nnw.	7.2	863	689.7	5.8	92	nnw.	10.4
10.07 a. m....	718.4	9.8	85	nnw.	6.7	1,092	670.5	5.2	80	nnw.	12.7
10.19 a. m....	718.4	10.3	81	nnw.	7.2	1,491	638.8	7.3	36	nnw.	14.8
10.31 a. m....	718.3	10.2	80	nnw.	6.7	2,207	585.2	2.5	42	nw.	16.0
10.45 a. m....	718.3	10.2	78	nw.	6.7	2,835	541.2	−0.5	100	nw.	29.4
11.07 a. m....	718.4	10.0	78	nw.	7.2	3,102	523.4	−1.4	100	wnw.	30.7
11.15 a. m....	718.4	9.9	79	nw.	6.7	3,578	493.1	−1.5	100	wnw.	....
11.35 a. m....	718.6	10.0	79	nw.	6.7	3,256	513.7	−0.7	100	wnw.	....
11.56 a. m....	718.8	10.0	80	nw.	6.7	2,919	535.8	−1.2	100	wnw.	....
12.28 p. m....	718.8	10.4	80	wnw.	6.3	2,509	564.0	0.2	100	nw.	24.0
12.38 p. m....	718.8	10.9	72	nw.	8.0	1,917	606.9	3.3	63	nw.	....
12.45 p. m....	718.8	11.2	69	nw.	9.4	1,624	629.1	7.2	43	nw.	....
12.50 p. m....	718.8	11.2	68	nw.	8.0	1,213	661.5	3.9	86	nw.	....
12.59 p. m....	718.8	11.8	64	nw.	8.5	883	688.7	7.2	82	nw.	11.2
1.06 p. m....	718.8	11.4	63	nw.	8.9	526	718.8	11.4	63	nw.	8.9
Sept. 14:											
1.05 p. m....	723.0	14.3	64	se.	6.3	526	723.0	14.3	64	se.	6.3
2.22 p. m....	722.4	15.5	64	se.	5.8	929	688.6	9.2	75	sse.	7.8
3.18 p. m....	722.0	15.7	64	se.	8.9	1,208	665.5	8.5	65	s.	7.0
4.10 p. m....	721.9	16.1	62	se.	7.6	1,669	629.3	5.8	69	ssw.	7.2
4.35 p. m....	721.9	16.1	64	se.	7.2	2,067	599.7	9.2	24	sw.	6.3
4.40 p. m....	721.9	16.0	63	sse.	7.2	2,235	587.6	8.2	22	sw.	6.7
4.46 p. m....	721.9	15.8	63	sse.	7.2	2,065	599.7	8.7	19	sw.	7.7
4.59 p. m....	721.9	15.6	65	sse.	7.2	1,680	628.4	6.0	61	ssw.	10.4
5.15 p. m....	721.9	15.5	67	sse.	8.0	1,220	664.5	8.4	82	s.	12.3
5.23 p. m....	721.9	15.3	66	sse.	8.0	863	693.6	11.0	75	s.	12.0
5.32 p. m....	721.9	15.0	69	sse.	7.2	526	721.9	15.0	69	sse.	7.2
Sept. 15:											
1.41 p. m....	716.4	19.9	90	sw.	4.9	526	716.4	19.9	90	sw.	4.9
1.56 p. m....	716.2	20.6	87	ssw.	4.9	816	692.7	21.1	70	wsw.	8.4
2.11 p. m....	716.0	20.2	88	ssw.	4.5	1,481	641.3	19.4	83	wsw.	16.0
2.28 p. m....	715.9	20.8	83	sw.	4.5	1,911	610.1	17.7	75	w.	15.2
2.42 p. m....	715.8	21.0	80	wsw.	5.4	2,675	557.5	11.1	84	wnw.	20.8
3.25 p. m....	715.7	21.0	84	sw.	5.8	3,517	503.7	4.3	93	w.	20.7
3.53 p. m....	715.7	21.2	83	sw.	5.4	2,583	563.9	12.5	86	w.	18.0
4.08 p. m....	715.7	21.4	81	sw.	4.9	1,930	609.1	16.6	87	w.	16.8
4.21 p. m....	715.7	21.6	81	sw.	5.8	1,500	640.3	20.5	72	w.	14.1
4.31 p. m....	715.8	21.8	81	wsw.	7.2	906	685.5	24.5	76	wsw.	16.0
4.34 p. m....	715.8	21.6	82	wsw.	7.6	526	715.8	21.6	82	wsw.	7.6

Fourth flight: Five kites were used; lifting surface, 31.5 sq. m. Wire out, 7,500 m.; at maximum altitude, 7,300 m.

There were 10/10 A.-St. from the northwest until 11.30 a. m., and from the west-northwest thereafter; altitude, 2,600 m.

September 14.—Seven kites were used; lifting surface, 46.6 sq. m. Wire out, 6,000 m.; at maximum altitude, 3,100 m.

There were about 7/10 Ci.-St. from the northwest, with solar halo. After 4.30 p. m. they were gradually obscured by A.-Cu. and A.-St. from the northwest, which covered the sky at 5.30 p. m.

A large high, central over the North Atlantic States, covered the eastern part of the country. Pressure was low over Saskatchewan.

September 15.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,400 m.

A.-St. and A.-Cu. from the west-northwest covered the sky. Light rain fell until 1.40 and from 3.43 to 3.50 p. m.

High pressure was central east of New England, low pressure north of Lake Superior.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
				Wind.						Wind.	
	Pressure.	Temperature.	Rel. hum.	Direction.	Velocity.	Height.	Pressure.	Tempera-	Rel. hum.	Direction.	Velocity.
1911.											
Sept. 16:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
10.45 a. m....	716.0	20.6	88	nw.	5.4	526	716.0	20.6	88	nw.	5.4
10.54 a. m....	716.0	21.1	86	nw.	5.8	882	687.2	18.3	75	nnw.	8.8
11.37 a. m....	716.0	21.3	81	nw.	6.3	1,128	667.8	18.7	58	n.	6.0
11.48 a. m....	716.0	21.3	81	nw.	4.9	1,503	638.8	14.5	78	nw.	6.3
11.54 a. m....	716.0	20.9	79	wnw.	7.2	1,166	664.8	17.6	62	nw.	7.3
12.04 p. m....	716.0	21.1	78	nw.	5.4	779	695.4	18.5	82	nw.	6.3
12.07 p. m....	716.0	21.2	79	nw.	5.4	526	716.0	21.2	79	nw.	5.4
Sept. 17:											
6.29 a. m....	717.2	16.0	68	nnw.	5.4	526	717.2	16.0	68	nnw.	5.4
6.34 a. m....	717.3	16.2	67	nnw.	4.9	719	701.4	17.6	58	n.	10.9
6.47 a. m....	717.3	16.8	67	nnw.	4.5	1,072	672.8	15.0	60	nne.	10.3
7.08 a. m....	717.4	17.4	62	nnw.	4.0	1,614	631.0	10.3	51	nne.	10.0
8.53 a. m....	717.6	18.8	71	wnw.	3.6	2,276	583.1	5.8	53	nne.	8.8
9.05 a. m....	717.6	19.4	65	wnw.	3.1	2,782	548.0	5.1	36	nne.	11.6
9.08 a. m....	717.6	19.5	65	wnw.	3.1	3,058	529.9	5.4	31	nne.	14.0
9.23 a. m....	717.6	20.0	68	w.	3.6	3,603	495.6	3.2	26	n.	12.4
9.37 a. m....	717.7	20.2	66	wnw.	4.0	2,938	538.0	5.4	27	n.	12.0
9.47 a. m....	717.7	20.1	68	w.	3.6	2,786	548.0	3.7	28	nne.	10.2
10.03 a. m....	717.7	20.3	66	wnw.	3.6	2,092	596.3	7.6	57	nne.	9.1
10.20 a. m....	717.7	21.0	66	w.	2.2	1,482	641.8	12.3	59	ne.	7.1
10.32 a. m....	717.8	21.4	65	nw.	2.2	931	685.0	17.3	59	ne.	5.5
10.36 a. m....	717.8	21.4	64	nw.	2.2	526	717.8	21.4	64	nw.	2.2
Sept. 18:											
2.53 p. m...	718.4	17.8	83	e.	3.6	526	718.4	17.8	83	e.	3.6
3.09 p. m...	718.3	18.0	82	ese.	4.9	2,050	600.5	11.3	......	nw.	....
3.30 p. m...	718.2	18.7	80	ese.	4.0	1,532	638.5	16.1	......	nw.	....
3.38 p. m...	718.1	18.4	80	e.	4.5	1,004	679.1	16.7	......	wsw.	....
3.45 p. m...	718.0	18.6	82	se.	4.9	792	696.1	15.3	......	se.	....
3.48 p. m...	718.0	17.4	84	se.	4.9	526	718.0	17.4	84	se.	4.9

September 16.—Four kites were used; lifting surface, 30.6 sq. m. Wire out, 2,000 m.; at maximum altitude, 1,200 m.

There were 4/10 A.-Cu. from the west and 4/10 St. from the north. The base of the St. was about 300 m. above the ground.

Pressure was low over Quebec with a secondary depression off the New Jersey coast. Pressure was high over Georgia.

September 17.—Five kites were used; lifting surface, 39.9 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,000 m.

After 9 a. m. there were a few Ci. from the west-northwest.

Pressure was high over Newfoundland and relatively high over West Virginia, and was low off the middle Atlantic coast.

September 18.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

Ci., from the northwest, and St.-Cu., from the southeast, diminished from 8/10 to 3/10; base of St.-Cu., about 800 m. altitude.

High pressure, central over the lower St. Lawrence, covered the Eastern States. Pressure was low over the Mississippi Valley and the upper Lakes.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 19:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
1.24 p. m...	714.0	22.0	78	wnw.	3.6	526	714.0	22.0	78	wnw.	3.6
1.44 p. m...	713.9	22.6	78	wnw.	4.0	1,623	628.7	16.2	......	nw.	....
1.53 p. m...	713.8	22.3	77	wnw.	4.2	1,419	643.7	17.0	......	nnw.	....
2.27 p. m...	713.6	23.4	74	wnw.	2.4	845	688.0	20.4	......	nw.	....
2.38 p. m...	713.5	23.6	76	nw.	2.2	526	713.5	23.6	76	nw.	2.2
Sept. 20:											
7.48 a. m....	716.6	15.8	90	nw.	8.5	526	716.6	15.8	90	nw.	8.5
7.56 a. m....	716.7	15.8	89	nw.	7.6	844	690.4	13.6	87	nnw.	11.2
9.33 a. m....	717.3	17.1	82	nw.	8.9	1,090	671.1	13.2	87	nnw.	6.9
10.56 a. m....	717.5	19.0	74	nw.	8.0	844	691.4	15.3	72	nnw.	11.6
11.04 a. m....	717.5	18.8	68	nw.	8.0	526	717.5	18.8	68	nw.	8.0
Sept. 21:											
6.42 a. m....	719.3	14.8	71	se.	6.3	526	719.3	14.8	71	se.	6.3
6.53 a. m....	719.4	15.2	71	se.	6.7	810	695.8	15.9	63	sse.	8.8
7.02 a. m....	719.4	15.2	71	se.	7.2	1,077	674.3	16.7	74	sse.	10.4
7.27 a. m....	719.4	15.8	72	se.	6.3	1,663	629.2	10.7	91	sw.	8.8
9.21 a. m....	719.5	17.0	72	se.	6.3	2,131	595.3	11.0	76	sw.	11.8
9.28 a. m....	719.5	17.0	73	se.	6.3	2,780	550.4	7.7	76	sw.	11.6
9.37 a. m....	719.6	17.5	71	se.	6.3	3,523	502.8	....	96	sw.	20.0
9.54 a. m....	719.6	17.8	71	se.	5.8	4,130	466.5	−0.9	76	wsw.	21.6
10.12 a. m....	719.6	18.3	70	se.	6.7	4,436	449.0	....	52	wsw.	22.6
10.27 a. m....	719.6	18.3	70	se.	6.7	4,728	432.4	− 6.6	81	wsw.	17.6
10.44 a. m....	719.6	18.0	71	se.	6.3	5,270	403.6	− 6.0	80	wsw.	18.4
10.55 a. m....	719.6	18.0	73	se.	5.8	5,371	398.4	− 7.3	76	wsw.	17.6
11.16 a. m....	719.6	17.1	79	se.	5.8	5,041	415.6	....	96	wsw.	....
11.50 a. m....	719.6	16.9	82	se.	5.8	4,340	453.8	− 2.8	94	wsw.	....
12.17 p. m....	719.5	17.0	80	se.	4.9	3,661	494.0	1.3	93	wsw.	15.4
12.35 p. m....	719.4	16.8	82	se.	4.9	3,207	522.2	4.1	92	wsw.	12.2
12.50 p. m....	719.4	17.0	84	se.	4.5	2,559	565.2	7.7	92	sw.	11.2
1.05 p. m....	719.3	16.8	85	se.	5.8	1,978	606.0	11.3	92	ssw.	13.6
1.30 p. m....	719.2	16.0	92	se.	6.7	1,139	669.2	16.1	86	ssw.	13.0
1.39 p. m....	719.1	16.0	92	se.	5.8	996	680.4	14.4	90	s.	....
1.46 p. m....	719.1	16.0	92	se.	5.8	526	719.1	16.0	92	se.	5.8

September 19.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,200 m.

At 1.24 there was 1/10 St.-Cu. from the west-northwest, at 2.30, 1/10 A.-St. and St.-Cu. from the north-northwest, and at 2.38, 3/10 A.-St. and A.-Cu. from the north-northwest.

Pressure was low over southeastern Ontario and off the Atlantic coast, and high pressure was central over the middle plains States.

September 20.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 3,750 m.; at maximum altitude, 2,700 m.

St.-Cu., from the northwest, decreased from 8/10 to 1/10.

Pressure was low off Nova Scotia and the New England States and high over the upper Lakes.

September 21.—Eight kites were used; lifting surface, 52.4 sq. m. Wire out, 9,000 m.; at maximum altitude.

About 2/10 St.-Cu. were followed by 9/10 A.-Cu. at 9 a. m., and by 10/10 A.-St. after 11 a. m., all from the west-southwest. About noon St.-Cu. from the southwest appeared and by 12.30 p. m. covered the sky. Light rain fell from 12.43 until 1.35 p. m.

Low pressure was central over southern Lake Michigan. Pressure was high over New England.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel- hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 22:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.18 a. m....	721.0	16.5	96	nw.	6.7	526	721.0	16.5	96	nw.	6.7
8.26 a. m....	721.0	16.9	92	nw.	8.5	893	690.5	13.8	81	nnw.	14.8
8.38 a. m....	721.0	16.8	92	nw.	9.4	1,462	645.4	11.4	79	nw.	18.4
9.01 a. m....	721.1	17.6	84	nw.	13.4	1,697	627.9	16.7	27	nw.	6.0
10.32 a. m....	721.7	19.5	69	nw.	9.8	2,288	586.0	11.4	25	nw.	5.2
10.43 a. m....	721.7	19.6	67	nw.	7.2	1,817	619.2	14.4	26	nw.	8.5
10.49 a. m....	721.7	19.4	68	nw.	6.3	1,611	634.7	9.1	57	nw.	16.4
11.00 a. m....	721.7	19.5	68	nw.	6.3	1,179	668.3	11.6	92	nnw.	11.8
11.07 a. m....	721.7	19.6	69	nw.	7.6	955	686.4	14.1	86	nnw.	11.2
11.17 a. m....	721.8	19.8	68	nw.	10.3	526	721.8	19.8	68	nw.	10.3
Sept. 23:											
10.31 a. m....	724.4	18.3	77	sse.	1.2	526	724.4	18.3	77	sse.	1.2
10.47 a. m....	724.4	18.1	77	se.	0.9	1,857	619.3	12.8	......	s.	....
10.55 a. m....	724.4	18.4	79	sw.	0.9	1,070	679.7	15.0	......	sse.	....
11.12 a. m....	724.3	18.9	78	sw.	1.0	835	698.6	16.5	......	sse.	....
11.32 a. m....	724.2	19.5	74	sse.	1.5	526	724.2	19.5	74	sse.	1.5
Sept. 24:											
11.26 a. m....	721.6	22.0	82	se.	2.6	526	721.6	22.0	82	se.	2.6
11.52 a. m....	721.4	23.6	80	se.	3.1	2,336	584.2	12.3	......	calm.	....
12.07 p. m....	721.4	23.5	79	ese.	3.1	1,684	630.9	15.9	......	calm.	....
12.21 p. m....	721.3	24.2	77	se.	2.2	1,033	680.5	20.0	......	sw.	....
12.25 p. m....	721.3	24.3	76	s.	2.3	526	721.3	24.3	76	s.	2.3

September 22.—Six kites were used; lifting surface, 38.3 sq. m. Wire out, 6,000 m.; at maximum altitude, 2,800 m.

There were about 6/10 Ci.-St. and A.-Cu. from the west throughout the flight, with solar halo between 8 and 9 a. m. St., from the northwest, altitude 800 m., decreased from 4/10 to few by 9 a. m. Cu. appeared about 10 a. m. and increased to 3/10.

Pressure was high over lower Michigan and comparatively low over New England.

September 23.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,200 m.

There were 9/10 to 10/10 St. from the south-southeast at an altitude of about 1,200 m. The balloon was hidden by the clouds from 10.40 to 10.57 a. m.

A well-developed high had its center over central New England and a trough of low pressure extended from Arizona to Lake Superior, with centers over southeastern Nebraska and northeastern Minnesota.

September 24.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m.

There were 3/10 to 1/10 St., whose direction was west-southwest at the beginning, south at 11.37 a. m., and doubtful at the end of the flight. 2/10 A.-St. from the west at the beginning of the flight soon disappeared. There was light haze.

Pressure was high over northern Minnesota and off the middle Atlantic coast and relatively low over the St. Lawrence Valley and Missouri.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 25:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
6.34 a. m....	719.3	20.1	86	w.	7.6	526	719.3	20.1	86	w.	7.6
6.47 a. m....	719.3	20.6	83	wsw.	7.2	762	700.0	21.7	68	wnw.	10.0
7.06 a. m....	719.3	20.7	82	w.	6.7	1,213	664.5	18.5	65	wnw.	10.1
7.37 a. m....	719.3	21.6	80	w.	7.2	1,684	629.0	14.5	68	wnw.	8.4
8.28 a. m....	719.3	20.6	78	w.	8.9	2,183	592.6	9.6	70	w.	8.4
8.50 a. m....	719.3	21.6	83	w.	8.9	2,760	552.8	3.6	88	w.	9.2
9.24 a. m....	719.3	22.7	77	w.	7.6	2,871	545.6	2.4	82	w.	12.1
10.10 a. m....	719.2	23.8	71	w.	7.2	4,014	473.1	−1.7	25	w.	19.3
10.35 a. m....	719.0	24.2	70	w.	7.2	4,336	454.2	−3.8	22	w.	19.5
11.23 a. m....	718.7	24.7	65	wnw.	8.9	5,104	408.8	....	69	w.	19.8
12.33 p. m....	718.3	25.7	59	w.	7.2	3,514	503.0	....	80	w.	13.8
12.57 p. m....	718.3	26.7	62	wsw.	6.3	2,977	537.4	....	43	w.	....
1.17 p. m....	718.2	26.6	58	nw.	4.0	2,305	583.2	9.3	76	wsw.	12.7
1.30 p. m....	718.1	26.7	55	wnw.	5.4	1,856	615.4	11.9	83	w.	11.2
1.45 p. m....	717.9	27.3	55	wnw.	5.4	995	680.6	20.0	68	wnw.	7.0
1.59 p. m....	717.9	26.6	54	wnw.	5.4	526	717.9	26.6	54	wnw.	5.4
Sept. 26:											
8.14 a. m....	718.2	20.2	78	wnw.	9.8	526	718.2	20.2	78	wnw.	9.8
8.24 a. m....	718.2	20.1	79	wnw.	8.9	943	684.3	16.8	81	nw.	20.0
8.40 a. m....	718.2	20.4	80	wnw.	8.5	1,496	641.2	14.1	68	nw.	18.4
8.54 a. m....	718.3	20.6	80	wnw.	7.2	2,060	599.7	10.4	65	nw.	20.3
9.03 a. m....	718.3	20.7	80	wnw.	8.9	2,483	569.8	7.5	68	nw.	20.4
9.38 a. m....	718.6	21.1	77	nw.	8.9	3,127	527.1	2.5	53	nw.	19.5
9.56 a. m....	718.8	21.4	74	nw.	8.9	3,916	477.7	−2.5	59	nw.	24.8
10.12 a. m....	718.9	21.5	71	nw.	11.6	4,289	456.0	....	46	nw.	28.1
10.22 a. m....	718.9	21.6	70	nw.	9.8	4,545	441.3	....	55	nw.	28.0
10.52 a. m....	719.1	21.3	68	nw.	8.5	4,884	422.6	....	17	nw.	29.0
10.58 a. m....	719.1	21.2	67	nw.	8.9	4,940	419.6	....	26	nw.	28.2
11.34 a. m....	719.2	20.9	69	nw.	8.9	4,210	459.1	....	13	nw.	25.5
12.11 p. m....	719.3	21.2	68	nw.	10.3	3,697	489.7	....	7	nw.	24.9
12.32 p. m....	719.4	21.2	65	nw.	9.4	3,126	526.1	....	48	nw.	25.0
12.55 p. m....	719.5	21.6	64	nw.	10.3	2,413	574.4	....	67	nw.	18.7
12.59 p. m....	719.5	21.6	64	nw.	9.4	2,310	581.8	....	56	nw.	19.9
1.05 p. m....	719.5	21.5	65	nw.	9.8	1,929	609.3	7.5	86	nw.	18.7
1.23 p. m....	719.5	21.4	68	nw.	9.8	1,401	649.2	11.1	93	nw.	13.3
1.33 p. m....	719.5	20.9	67	nnw.	10.3	996	681.2	14.2	79	nnw.	13.6
1.42 p. m....	719.5	20.3	71	nw.	9.8	526	719.5	20.3	71	nw.	9.8

September 25.—Ten kites were used; lifting surface, 65.0 sq. m. Wire out, 11,000 m.; at maximum altitude, 9,800 m.

There were few to 4/10 Ci.-Cu. and A.-Cu. from the west until 9 a. m. Thereafter few to 3/10 Cu. moved from the west until about 12.30 p. m., then from the west-southwest. The head kite was in base of the Cu. at 1.20 p. m., altitude about 1,900 m.

Pressure was high over the Missouri Valley and eastern Canada and over the Southeastern States, and was relatively low over central New England.

September 26.—Six kites were used; lifting surface, 38.3 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,600 m.

Few to 1/10 Ci.-Cu. from the northwest prevailed until 11 a. m.; few Ci.-St. from the west-northwest were visible between 10 and 11 a. m. Throughout the flight there were 3/10 to 7/10 St.-Cu. from the northwest at an altitude of 1,300 m.

Pressure was high over the upper Lakes and low off the North Atlantic States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 27:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
7.56 a. m....	720.4	11.4	78	se.	5.8	526	720.4	11.4	78	se.	5.8
8.04 a. m....	720.4	11.4	78	se.	6.7	1,099	672.8	12.4	......	sw.	16.0
8.13 a. m....	720.4	11.6	77	se.	6.3	1,269	659.4	11.0	......	sw.	14.4
8.25 a. m....	720.4	11.6	79	se.	4.9	1,561	636.8	12.9	......	wsw.	16.0
8.51 a. m....	720.3	12.1	79	sse.	6.3	2,432	573.4	5.7	......	w.	19.3
9.10 a. m....	720.3	13.1	78	se.	6.7	3,005	535.0	7.1	......	wnw.	16.0
9.59 a. m....	720.2	14.4	74	se.	5.8	4,005	473.1	−0.7	......	wnw.	16.8
10.53 a. m....	719.7	16.0	73	sse.	7.2	4,822	426.7	−9.1	......	wnw.	21.2
11.35 a. m....	719.2	16.7	72	s.	7.2	4.007	473.1	−2.6	......	wnw.	19.6
12.02 p. m....	719.0	17.2	72	s.	6.7	3,298	516.6	3.2	......	wnw.	18.4
12.31 p. m....	718.7	18.1	68	s.	6.7	2,151	593.3	12.9	......	wnw.	16.8
12.40 p. m....	718.6	18.3	70	s.	7.6	1,883	612.4	14.8	......	wnw.	17.2
12.43 p. m....	718.6	18.3	72	s.	5.8	1.662	628.6	11.9	......	wnw.	19.6
1.00 p. m....	718.4	18.6	69	s.	7.6	1,039	676.5	15.5	......	sw.	12.8
1.10 p. m....	718.4	18.9	70	sse.	8.5	885	688.9	14.9	......	s.	....
1.15 p. m....	718.3	18.8	70	sse.	7.2	526	718.3	18.8	70	sse.	7.2
Sept. 28:											
6.48 a m....	718.1	17.2	100	nw.	10.3	526	718.1	17.2	100	nw.	10.3
7.18 a. m....	718.3	16.2	95	nw.	8.5	1.504	639.9	12.2	94	nw.	18.0
7.25 a. m....	718.3	16.1	94	nw.	8.5	1,715	624.1	12.0	......	wnw.	....
7.33 a. m....	718.4	16.1	95	nw.	6.3	1.944	607.4	13.3	34	wnw.	18.6
7.53 a. m....	718.5	16.2	90	nnw.	7.4	2,489	569.3	10.4	23	nw.	15.6
8.06 a. m....	718.6	15.8	90	nw.	8.8	2,739	552.6	7.9	15	nnw.	19.1
8.24 a. m....	718.8	15.8	86	nw.	8.9	3,119	527.6	3.3	19	wnw.	19.5
8.39 a. m....	719.1	15.9	86	nw.	8.8	3,841	482.6	−1.3	23	wnw.	20.0
9.12 a. m....	719.5	16.3	81	nw.	7.8	4.498	444.2	−8.2	20	wnw.	20.0
9.48 a. m....	719.7	16.5	78	nw.	7.8	3,830	483.7	−2.0	18	wnw.	19.2
10.19 a. m....	719.8	16.9	74	nw.	7.4	3,298	516.9	2.4	18	wnw.	15.1
11.06 a. m....	719.9	17.1	62	nw.	8.8	1,554	....	10.8	11	wnw.	15.0
11.21 a. m....	719.9	16.8	65	nw.	8.2	1,009	679.9	10.7	57	nw.	12.4
11.40 a. m....	720.0	17.1	70	nw.	7.8	526	720.0	17.1	70	nw.	7.8

September 27.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 10,000 m.; at maximum altitude, 9,500 m.

The sky was covered with St.-Cu. from the west-southwest until 9 a. m.; with Ci.-St., Ci.-Cu., and A.-St. from the northwest thereafter. Solar halo at intervals after 9.45 a. m. The head kite was in St.-Cu. at intervals from 8.10 to 9 a. m.; altitude of base, about 1,000 m.

Pressure was low over the upper Lakes and was high over the northern and middle Atlantic coast.

September 28.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 7,500 m.; at maximum altitude, 7,100 m.

There was fog at intervals until about 7.15 a. m. 9/10 St. from the northwest at 6.34 a. m. had disappeared by 8 a. m. A solar halo was visible after 7.15 a. m. 7/10 Ci.-St. from the west-northwest at 7.13 a. m. had increased to 10/10 by 7. 48 a. m., and had entirely disappeared by 11.06 a. m. 1/10 A.-St. from the west-northwest at 7.13 a. m. had increased to 10/10 A.-St. at the close of the flight.

Pressure was high over the Lake region and Ontario and centers of low pressure overlay the Gulf of St. Lawrence and southeastern Nebraska.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911.											
Sept. 29:											
First flight	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
10.43 a. m....	711.9	21.3	80	wsw.	9.4	526	711.9	21.3	80	wsw.	9.4
10.55 a. m....	711.8	21.2	80	sw.	9.4	1,081	667.7	19.7	60	w.	20.0
11.03 a. m....	711.8	21.2	81	wsw.	8.9	1,467	638.4	14.6	78	w.	20.1
11.05 a. m....	711.8	21.2	81	wsw.	8.9	1,718	....	14.4	92	w.	26.4
11.21 a. m....	711.6	21.6	81	wsw.	8.0	1,943	603.1	12.5	68	wnw.	27.2
12.04 p. m...	711.2	24.2	71	wsw.	8.5	526	711.2	24.2	71	wsw.	8.5
Second flight											
1.31 p. m...	710.2	24.8	66	w.	11.6	526	710.2	24.8	66	w.	11.6
1.42 p. m...	710.1	25.5	63	wsw.	11.2	978	674.3	20.3	58	w.	19.2
1.57 p. m...	709.9	25.7	62	wsw.	11.6	1,557	630.2	14.1	94	w.	25.0
2.14 p. m...	709.8	25.2	65	w.	12.1	2,265	579.0	7.8	100	wnw.	....
2.17 p. m...	709.8	25.3	64	w.	12.1	2,294	576.8	7.9	53	wnw.	....
2.28 p. m...	709.7	25.4	63	w.	11.2	2,922	534.2	3.0	92	wnw.	31.2
2.31 p. m...	709.7	25.2	64	w.	11.2	526	709.7	25.2	64	w.	11.2

September 29.—First flight: Three kites were used; lifting surface, 18.9 sq. m. Wire out, 3,100 m.; at maximum altitude.

There were 5/10 to 7/10 A.-Cu. from the west-northwest. There were 3/10 to 1/10 St.-Cu. from the west-northwest until 10.55 a. m. and a few to 1/10 Ci. from the west after 11.21 a. m.

Second flight: Four kites were used; lifting surface, 21.6 sq. m. Wire out, 5,000 m.; at maximum altitude.

There were a few to 1/10 Ci. from the west and 6/10 to 8/10 St.-Cu. from the west-northwest; altitude, 2,000 m.

Pressure was low over Lake Ontario and high over the Dakotas and over Georgia.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
1911. Sept. 30:	*mm.*	° *C.*	%		*m. p. s.*	*m.*	*mm.*	° *C.*	%		*m. p. s.*
8.10 a. m....	718.7	11.9	79	nnw.	8.0	526	718.7	11.9	79	nnw.	8.0
8.24 a. m....	718.9	12.0	76	nnw.	11.2	941	683.9	7.4	87	nnw.	18.0
8.36 a. m....	719.0	11.6	75	nnw.	9.8	1,308	653.9	4.2	92	nw.	16.8
8.54 a. m....	719.3	12.0	74	nnw.	10.3	1,513	638.1	3.5	86	nw.	18.4
8.55 a. m....	719.4	12.0	74	nnw.	10.3	1,564	634.1	7.0	59	nw.	18.4
8.57 a. m....	719.4	11.9	74	nnw.	10.3	1,614	630.3	5.7	61	nw.	16.8
9.00 a. m....	719.4	11.8	74	nw.	11.2	1,627	629.3	7.5	50	nw.	16.8
9.21 a. m....	719.3	12.2	71	nw.	8.9	2,280	581.6	10.1	22	nw.	15.6
9.34 a. m....	719.3	12.2	70	nw.	9.8	2,481	567.7	10.3	15	nnw.	14.4
10.17 a. m....	719.3	12.6	68	nw.	10.3	3,030	531.3	5.7	7	nnw.	14.4
10.40 a. m....	719.6	13.0	66	nw.	9.4	3,432	505.9	3.5	6	nnw.	15.8
10.52 a. m....	719.7	13.1	65	nw.	10.3	2,871	542.1	6.4	6	nnw.	13.0
11.00 a. m....	719.8	13.1	65	nw.	10.7	2,369	576.1	9.3	6	nnw.	12.8
11.09 a. m....	719.8	13.2	64	nw.	10.7	2,210	587.2	10.4	6	nnw.	11.2
11.14 a. m....	719.8	13.3	63	nw.	10.3	2,011	601.4	9.6	6	nw.	11.2
11.17 a. m....	719.8	13.4	63	nw.	10.3	1,852	612.9	10.2	9	nw.	10.4
11.20 a. m....	719.8	13.3	64	nw.	8.9	1,598	632.1	5.5	13	nw.	12.4
11.31 a. m....	719.8	13.7	63	nw.	8.9	1,198	663.8	4.6	......	nw.	11.8
11.42 a. m....	719.8	13.6	61	nw.	10.3	941	685.0	7.6	79	nw.	11.1
11.48 a. m....	719.8	13.8	62	nw.	11.6	526	719.8	13.8	62	nw.	11.6

September 30.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 6,100 m.; at maximum altitude, 4,800 m.

6/10 to 7/10 Ci.-Cu. gradually changed between 10 and 11 a. m. to Ci.-St.; direction, west-northwest. There were also 2/10 to 3/10 St.-Cu. from the northwest at an altitude of 1,300 m.

Pressure was high over Lake Huron and low off Nova Scotia

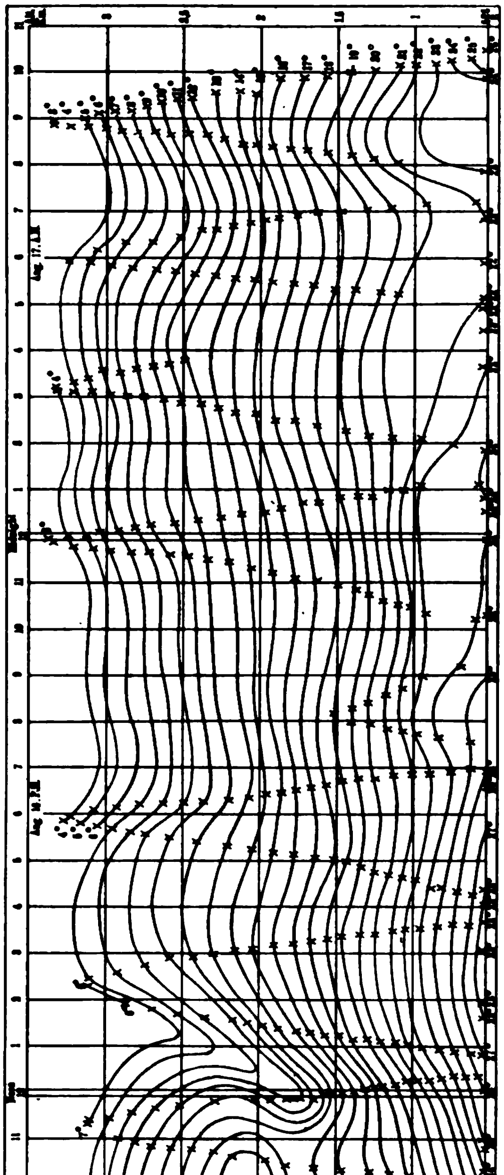

FIG. 7.—Free air isotherms, Aug. 16 and 17, 1911.

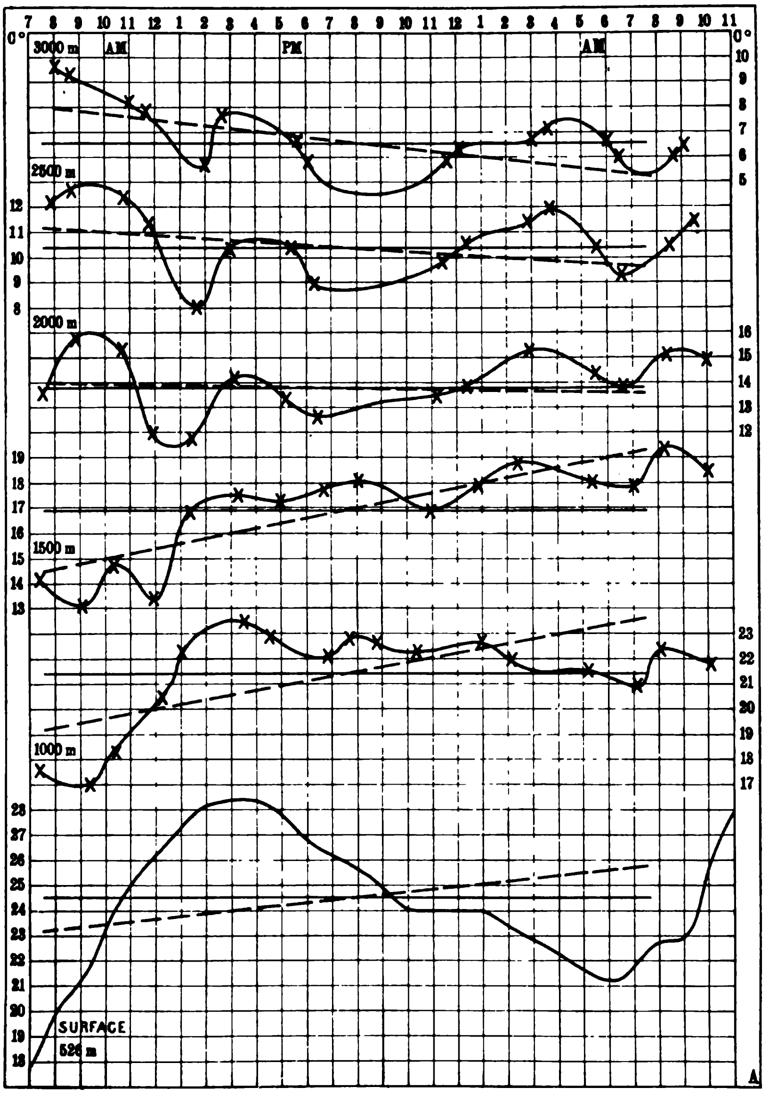

FIG. 8.—Free air temperatures, at different levels, Aug. 16–17, 1911.

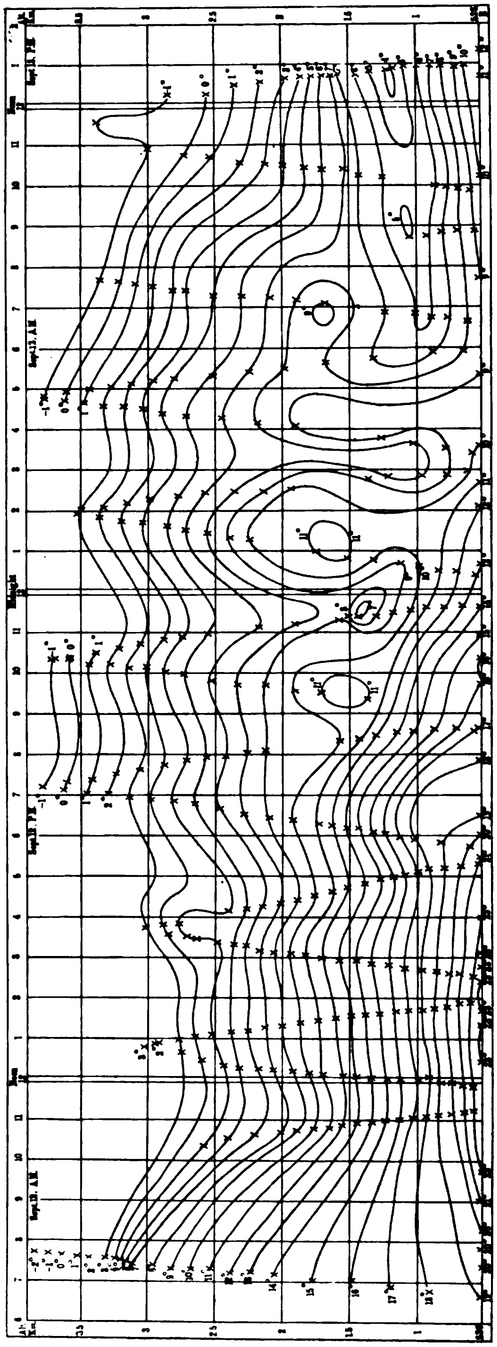

Fig. 9.—Free air isotherms, Sept. 12 and 13, 1911.

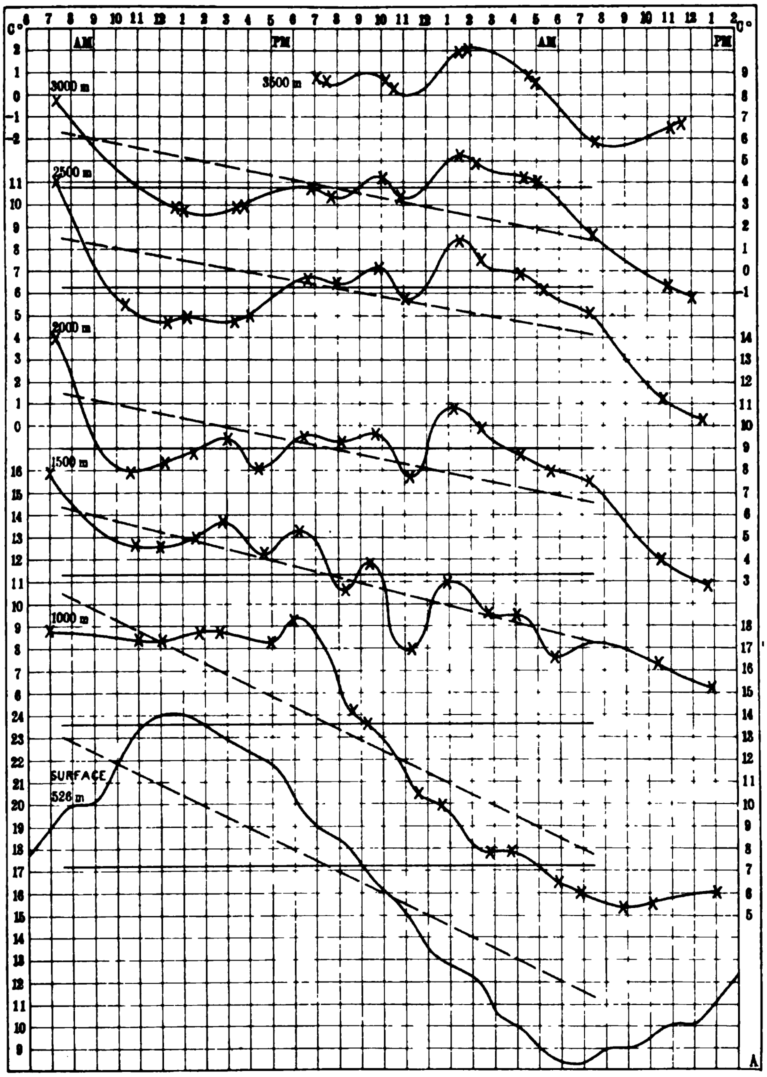

FIG. 10.—Free air temperatures, at different levels, Sept. 12 and 13, 1911.

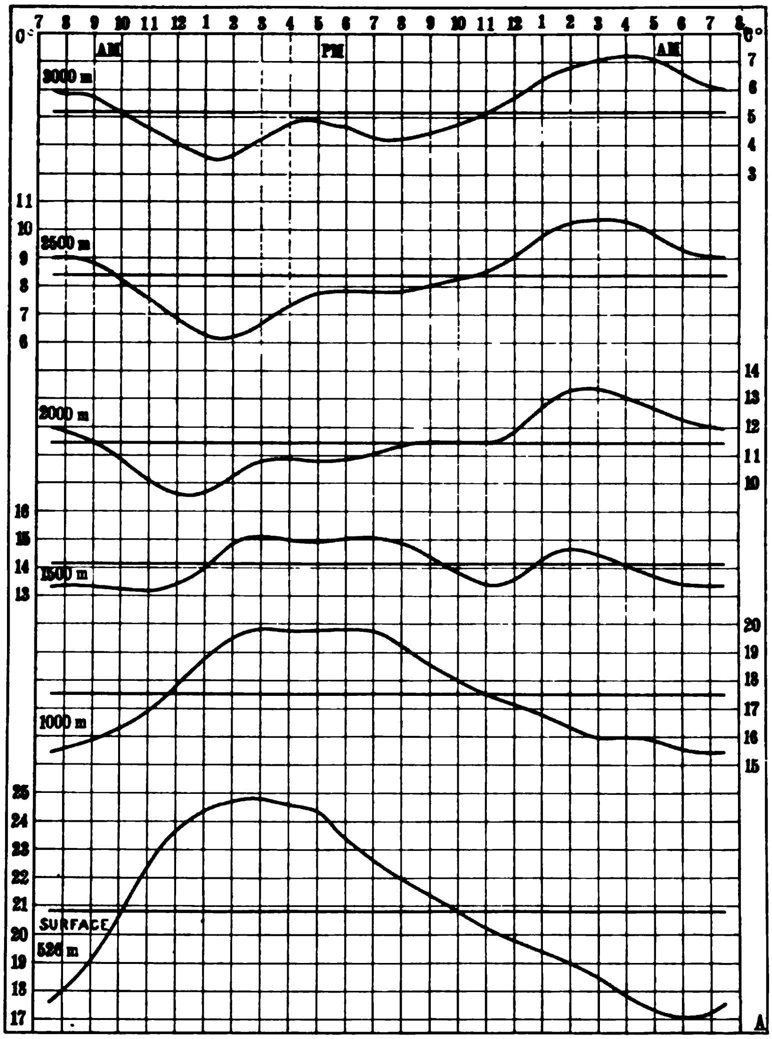

FIG. 11.—The daily temperature range at different levels from observations made Aug. 16 and 17, and Sept. 12 and 13, 1911.

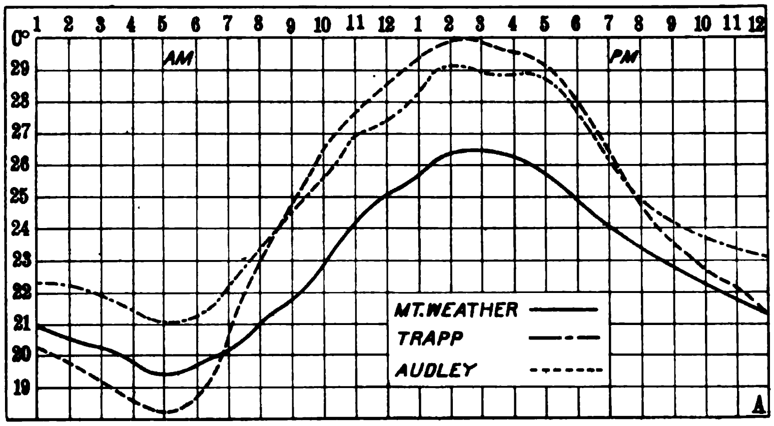

FIG. 12.—Mean hourly temperatures, July, 1911.

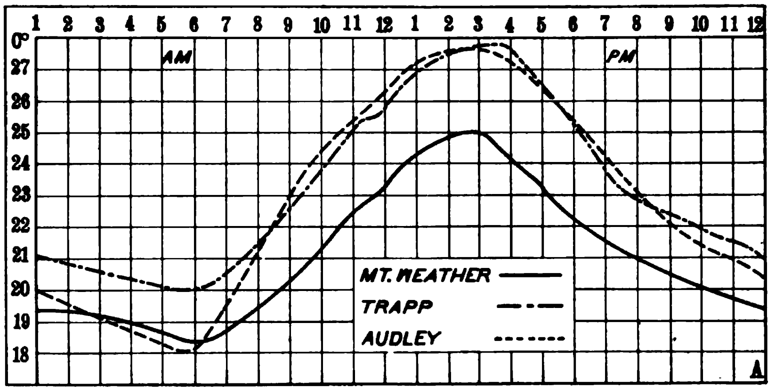

FIG. 13.—Mean hourly temperatures, Aug., 1911.

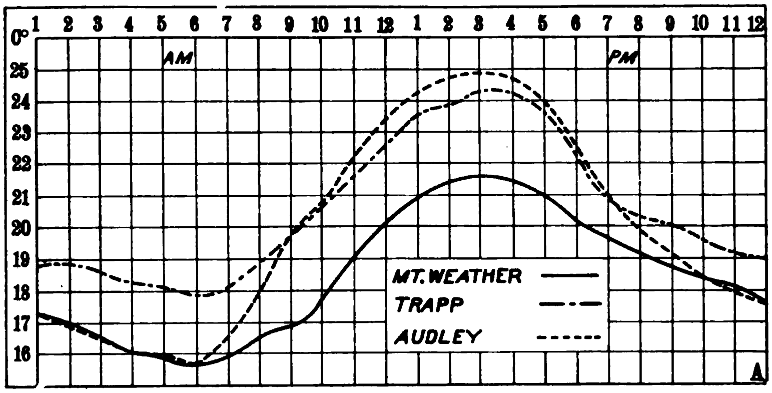

FIG. 14.—Mean hourly temperatures, Sept., 1911.

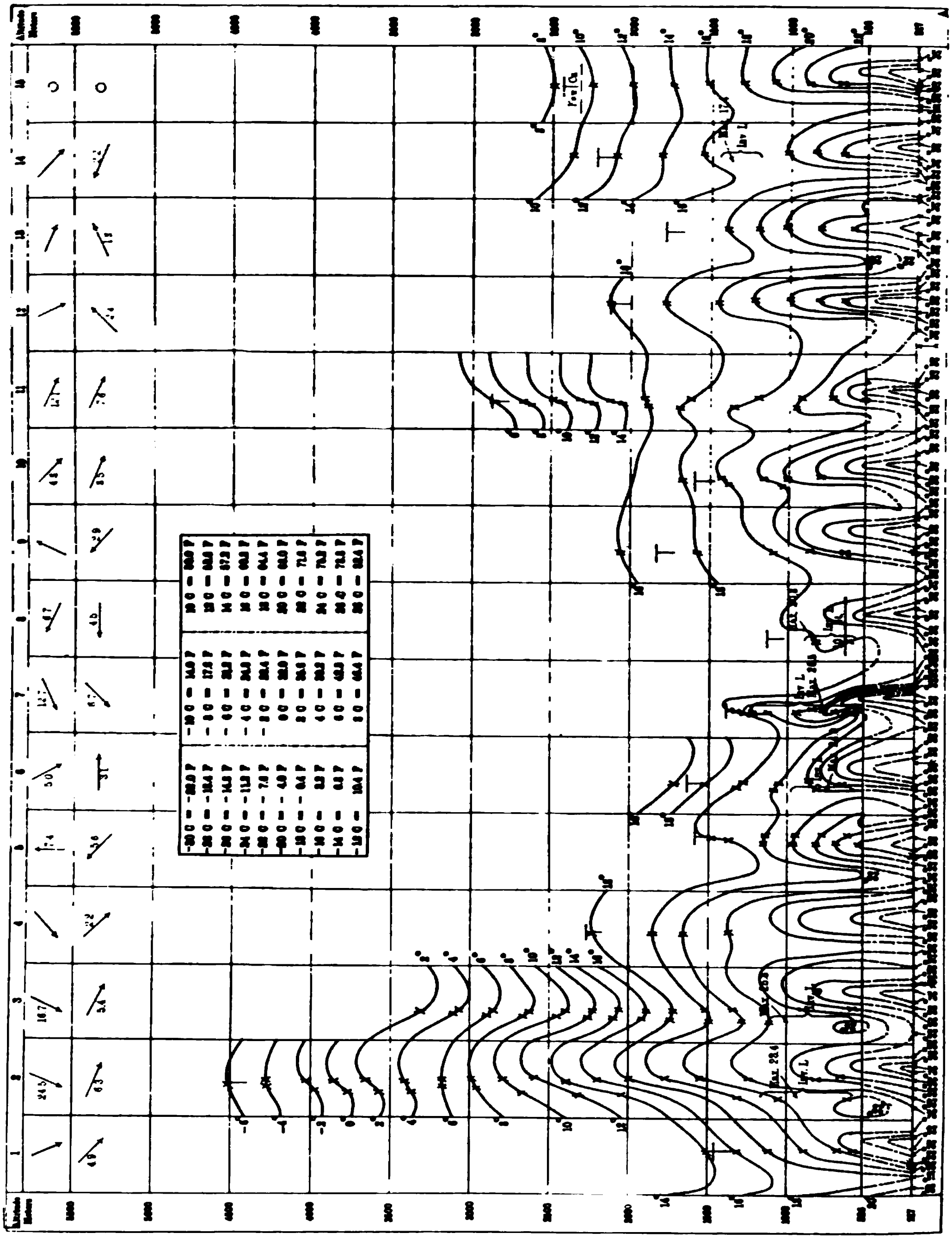

CHART No. XIII. Free air isotherms, July 1-15, 1911.

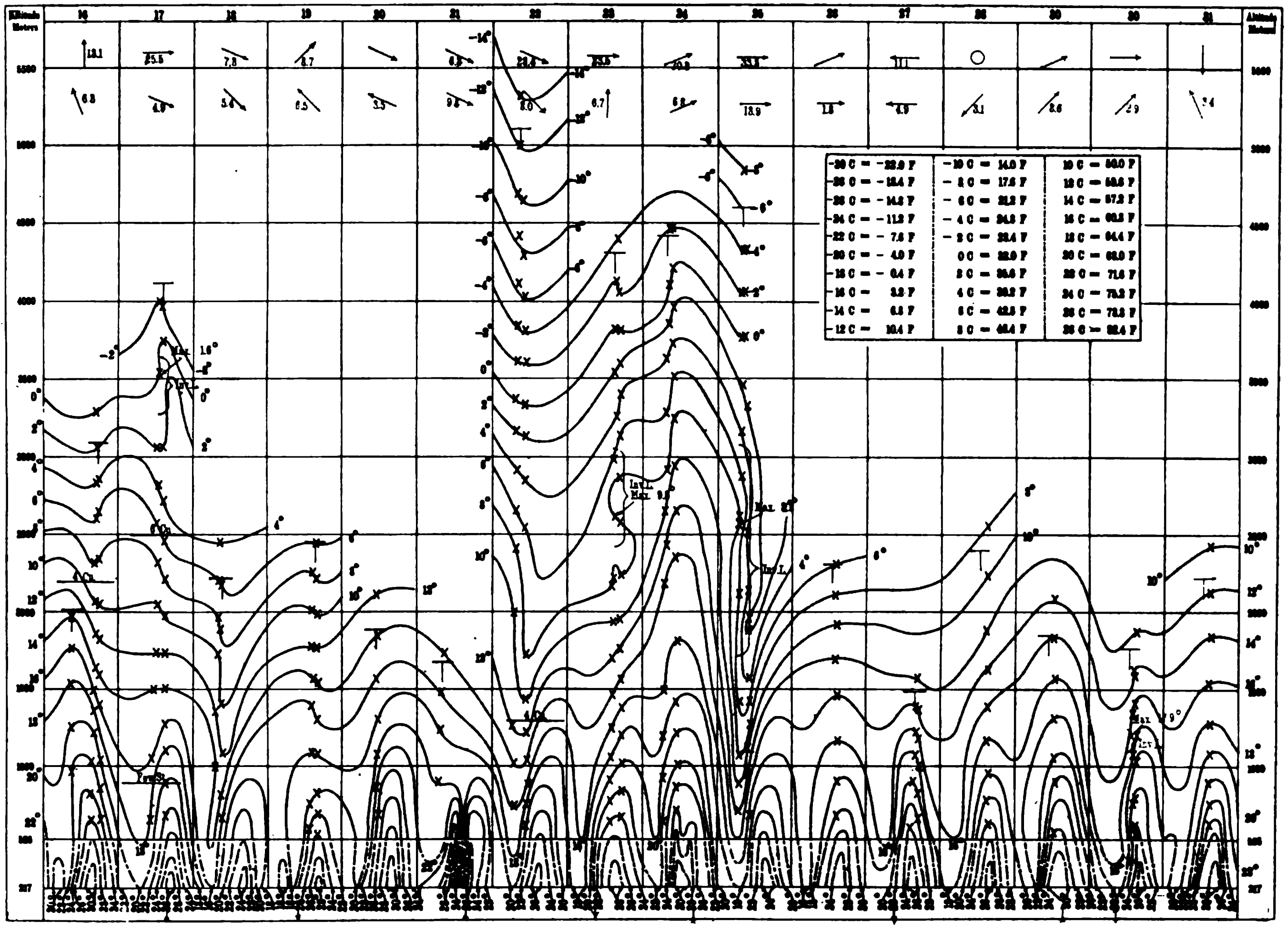

CHART No. XIV.—Free air isotherms, July 16-31, 1911.

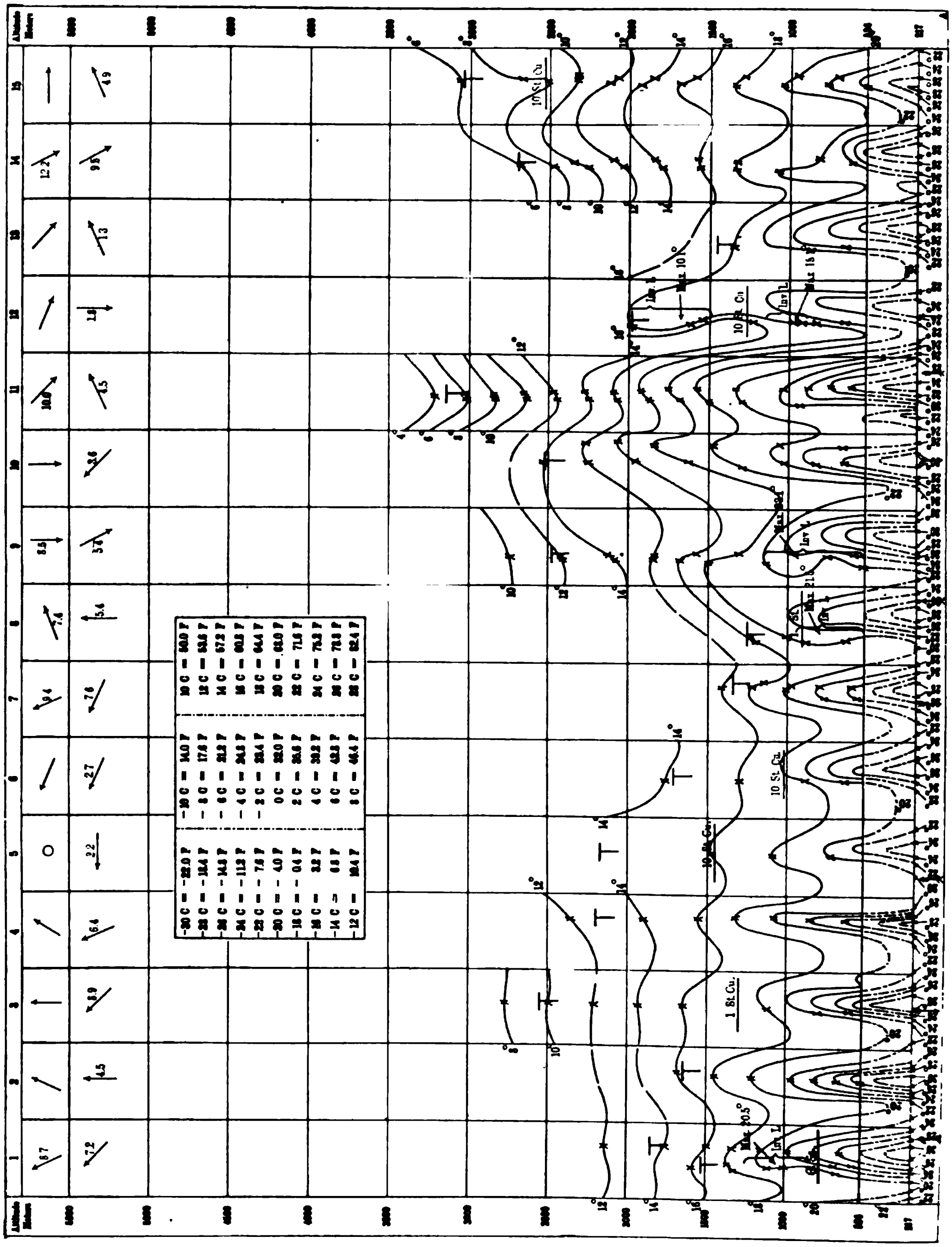

CHART No. XV.—Free air isotherms, Aug. 1-15, 1911.

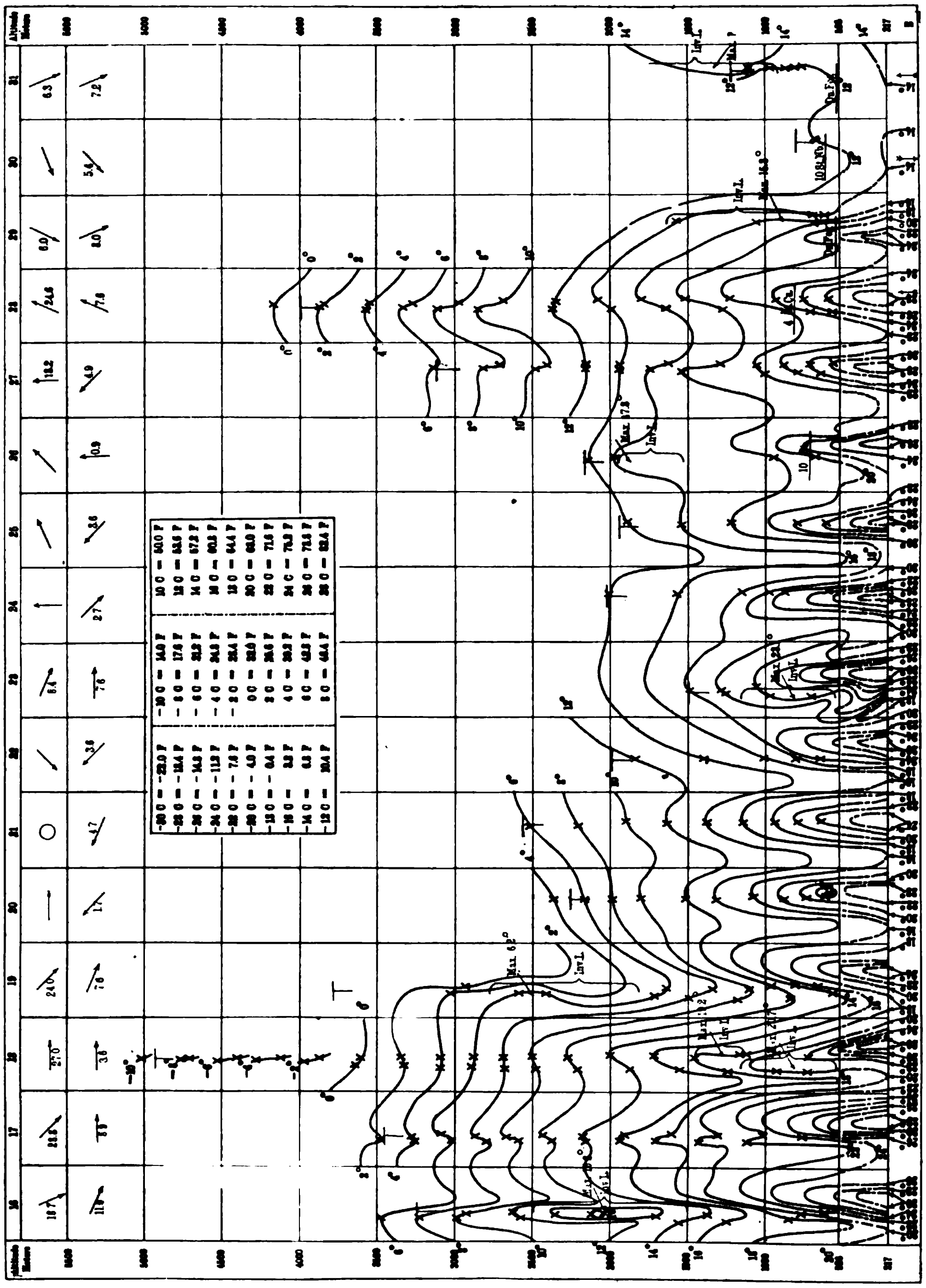

CHART No. XVI.—Free air isotherms, Aug. 16–31, 1911.

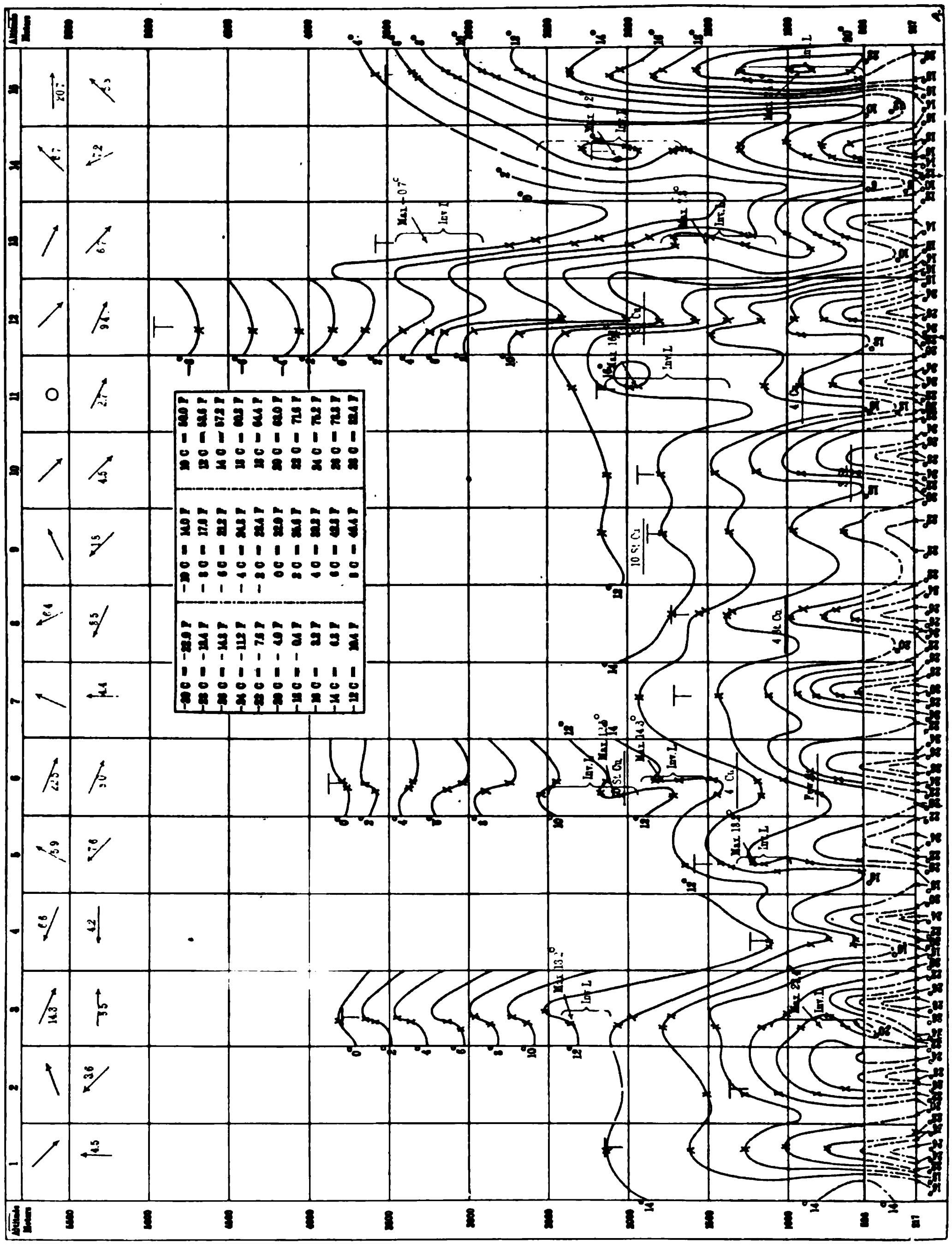

CHART No. XVII.—Free air isotherms, Sept. 1-15, 1911.

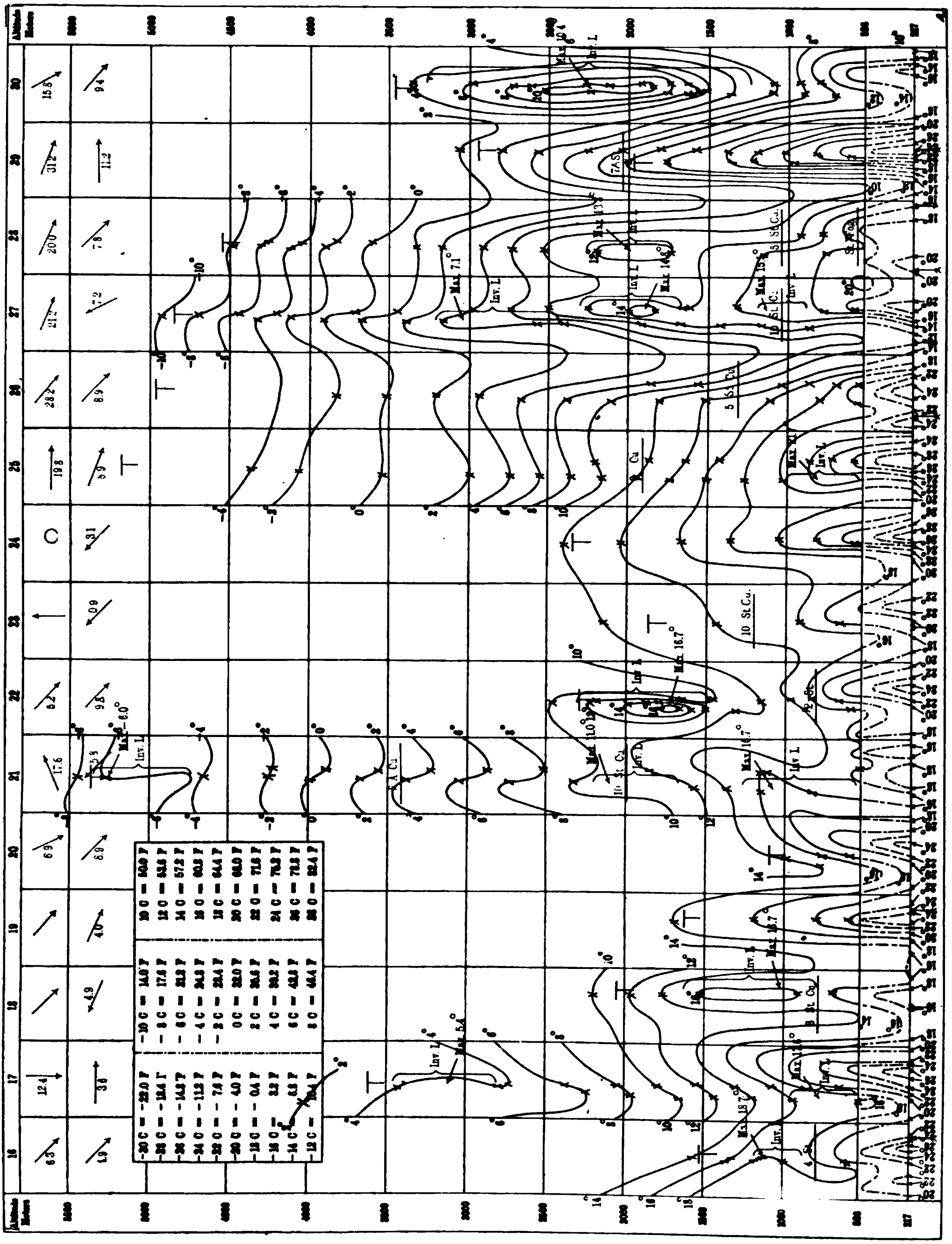

CHART No. XVIII.—Free air isotherms, Sept. 16–30, 1911.

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W. B. No. 482. Issued June 1, 1912

U. S. DEPARTMENT OF AGRICULTURE

Vol. 4

BULLETIN

Part 6

OF THE

MOUNT WEATHER OBSERVATORY

PREPARED UNDER THE DIRECTION OF

WILLIS L. MOORE, D. Sc., LL. D.

CHIEF U. S. WEATHER BUREAU

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(XX) DUST LAYERS IN THE ATMOSPHERE AND CHANGES IN THE NEUTRAL POINTS OF SKY POLARIZATION.

By W. J. HUMPHREYS.

[Dated February, 1912,]

It is well known that sky light is, in general, partially polarized, and that the percentage of polarization varies from one point to another in the sky and also from day to day.

If the light is analyzed into vibrations parallel and perpendicular, respectively, to the horizon, certain neutral arches will appear whose direction at every point makes an angle of 45° with the plane of polarization. If, however, the analysis of the light is not into these two arbitrary planes but into the planes of maximum and minimum vibration, and if the direction indicated by the maximum vibration be followed, one is led to a neutral point, the lowest or highest, as the case may be, of the above-mentioned arches. The lowest, if it is above either the sun or the antisolar point; the highest, if it is below either of them. In this latter case, however, only one of these points, the one below the sun, known as "Brewster's neutral point," can be actually observed; the other is always in the shadow of the earth, and, in fact, is purely imaginary.

Along the sun's vertical, but between the sun and its nearly equally distant neutral points, Brewster's below it and Babinet's above, the polarization plane is parallel to the horizon, as it also is between the antisolar point and its companion, Arago's neutral point. Between Babinet's point and Arago's point, however, the plane of polarization along the sun's vertical is perpendicular to the horizon. Hence, when observations are confined to the sun's vertical, as they often are, the neutral points are those points of this vertical at which the two polarizations, vertical and horizontal, are equal.

The vertical polarization is due almost entirely to the primary scattering of solar light by the dust in and the molecules of the atmosphere, while the horizontal polarization appears to be due essentially to secondary scattering. And as both the relative and the absolute intensities of these two quantities of light, as seen by an observer at the surface of the earth, are functions of the amount and distribution of dust in the atmosphere, it follows that the positions of the neutral points must also be functions of the dust in the atmosphere and its distribution.

Lengthy discussions of these interesting phenomena, with references to original articles, are given in certain works on optics, notably in Meteorologische Optik, by Pernter and Exner, and in Tatsachen und Theorien der atmosphärischen Polarisation, by Busch and Jensen. But the above simple statements, presumably, are a sufficient introduction for the purpose of this article, which is to point out the reasons for certain observed rapid changes in the solar and antisolar distances of the neutral points.

An extensive and valuable series of observations of the neutral points has recently been published by Süring,[1] whose investigations show, among other things:

a. That the first maximum solar distance and the minimum antisolar distance of the Babinet and the Arago points, respectively, occur when the sun is about 1° below the horizon, due to the passage of its rays through the lowest dust layer.

b. That there are isolated cases of rapid changes in the position of the Arago point when the sun is anywhere from 1°.5 to 3°.5 below the horizon.

c. That not only individual measurements but also the annual average shows that just after the sun passes beyond 3°.5 below the horizon a rapid change in the position of the Arago point often occurs.

d. That when the sun is rather less than 5° below the horizon the upper inversion layer, about 11 kilometers above the surface of the earth, becomes effective, as is shown both by exceptionally small solar distances of the Babinet point and by rapid increases in the antisolar distance of the Arago point.

Süring holds that the rapid changes in the position of the Arago point, when the sun is just more than 3°.5 below the horizon, may be accounted for by some sort of a layer boundary at the level of about 4 kilometers. He also thinks that such a layer would account for that secondary minimum in the height of the Babinet point which occurs when the sun is 3°, on the average, below the horizon. "Man wird diese Änderungen im Wachsen des Arago-Punktes wohl damit in Zusammenhang bringen können, dass hier die grosse Schichtgrenze—die effektive Strahlungsoberfläche nach Humphreys—überwunden ist, welche oberhalb von 4,000 m liegt. In derselben Weise ist das sekundäre Minimum für die Höhe des Babinet-Punktes bei durchschnittlich $-3°$ Sonnenhöhe zu erklären."

---

[1] Ergebnisse der meteorologischen Beobachtungen in Potsdam im Jahre 1910. Berlin, Behrend & Co 1911.

The author fully agrees with Süring in thinking that all these rapid changes in the solar and antisolar distances of the neutral points are attributable to distinct layers of some sort in the atmosphere, and it is the more specific purpose of what follows to indicate the probable nature (dust) and origin of these layers. In particular to show that dust layers sufficient in number and position to account for Süring's observed phenomena must occur, and that, in general, only these particular dust layers do or can occur.

The effective radiating surface, "Strahlungsoberfläche," referred to, is not an actual surface at all in any sense of the term. Radiation from the earth to space—the earth's planetary radiation—is directly given off chiefly by water vapor and, in the main, by that particular water vapor that is some distance above the surface, as Abbot and Fowle[1] have very clearly explained. Direct radiation to space, as they further explain, is not all from any one level. The lower levels radiate chiefly to the next above, and these in turn to still higher. At each increase of elevation the percentage of radiation that gets directly through to space increases, till that from elevations of, say, 8 kilometers or more is but slightly absorbed by the dry atmosphere beyond. The total amount of this radiation to space from all levels combined and from the entire atmosphere is substantially what would be given off by a dense layer of water vapor, or, what comes essentially to the same thing, by a perfectly black surface, or full radiator, at the temperature that prevails at an elevation of about 4 kilometers. Of course the average temperature, quantity, and distribution of water vapor in the atmosphere must, since it is the chief radiator, more or less closely conform to the general law that the annual amount of heat gained by the earth is substantially equal to its loss of energy by radiation during the same time.

It remains now to point out that the three dust layers called for by Süring's observations do exist, and how they are formed.

The first of these, effective in its action on the position of the neutral points when the sun is only about 1° below the horizon, is only that lower and relatively dense layer of dust, seldom more than 1 kilometer thick, that is so frequently seen from mountain tops and from balloons. It is essentially a dry-weather condition and is due to dust caught up from the surface of the earth by winds at times when there is but little vertical convection—not enough to carry it beyond the lower levels.

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[1] Annals of the Astrophysical Observatory, Smithsonian Institution, Vol, II, p. 173.

The second dust layer, effective when the sun is roughly 3°.5 below the horizon and therefore extending to an elevation of about 4 kilometers, is due to that great quantity of dust that is distributed through the atmosphere up to this level at the times of rather strong vertical convection, or at the times when cumulus clouds prevail. It is well known that 4 kilometers is one of the levels of maximum cloud formation—the level of the cumulus cloud. That is, it is the ordinary limit of vertical convection during clear weather. Hence, as a result of this considerable and frequent mixing of the lower atmosphere from the surface of the earth up to a level that averages 3 to 4 kilometers there must in general be considerably more dust up to this same level than there is at greater elevations.

The vertical temperature gradient through the first 3 kilometers or so, generally is much less than the adiabatic, and hence ordinary convection, cumulus clouds,[1] and, of course, the corresponding dust layer, usually are all restricted to comparatively low levels.

Strong cyclonic storms, however, produce convections that overcome the temperature gradient of the lower atmosphere and extend quite to the undersurface of the isothermal region, beyond which level vertical convection obviously can not greatly extend.

Dust, therefore, in greater or less extent is distributed, on such occasions, throughout the convective region, and somewhat accumulated at that other level of maximum cloudiness—the cirrus level, or the undersurface of the isothermal region, 11 kilometers or thereabouts above the surface of the earth.

To be sure these dust particles may be laden with moisture, just as is the case in the cumulus clouds, but in each case evaporation leaves the dust behind.

This then is the third and the last possible dust layer of the convective atmosphere, each layer in turn being of increasing thickness and decreasing density, and all three, but no more, are essential to the physical interpretation of Süring's observations.

As just stated there can be no other prevailing dust layer in the region of vertical convection; but at times there seems to be an entirely different sort of dust layer, probably of volcanic origin, and known as noctilucent clouds, whose height seems to be about 80 kilometers. However, it does not appear that the effect of this layer on the position of the neutral points has ever been studied, or even definitely detected.

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[1] Humphreys, Levels of Maximum and Minimum Cloudiness, Bull. Mt. Weather Observatory, vol. 4, p. 18, 1911.

SUMMARY.

Observed rapid changes in position of the Arago and Babinet points of neutral sky polarization seem to be accounted for by three separate dust layers in the lower atmosphere.

Three such layers must occur, and, in general, only three such layers can occur. These are:

a. A layer of relatively heavy and dense dust that seldom is more than 1 kilometer thick—due essentially to surface winds.

b. A layer of somewhat lighter dust, and less dense, extending to the level of the cumulus clouds, say 4 kilometers, and, like them, due to rather strong vertical convection.

c. A layer, the least dense of all, that extends to the undersurface of the isothermal region, due chiefly to the convection of cyclonic storms.

(XXI) THE UPPER ATMOSPHERE.

By W. J. HUMPHREYS.

[Dated Mar. 15, 1912.]

By the aid of sounding balloons it has been learned that the temperature of the atmosphere decreases with increase of elevation till, in middle latitudes, a temperature of about −55° C. is reached in the neighborhood of 11 kilometers above sea level; and that from this elevation up to the greatest height yet reached, some 30 kilometers, and presumably still further, the temperature is substantially constant at −55° C.

From meteors it has been learned that the atmosphere is still of perceptible density at an elevation of 150 kilometers, and that above 100 kilometers it consists, in part at least, of hydrogen.

Auroras, too, indicate an atmosphere of great elevation, though the measurements are far from accurate. Their spectra show the presence of nitrogen and seem also to indicate hydrogen, helium, and at least one other substance which at present is not certainly known. The strong green line, λ 5570, of this unknown substance agrees closely in position with a strong krypton line, but it is not probable that so heavy a gas as krypton can be in the outer atmosphere to any appreciable extent—the seeming agreement in position may be a mere coincidence.

Twilight phenomena indicate an atmosphere extending to an elevation of 70 to 80 kilometers in sufficient density to scatter an amount of light quite perceptible to the unaided eye.

Measurements on noctilucent clouds have indicated elevations equal to the highest demanded by twilight phenomena, 80 kilometers, but the nature and origin (presumably volcanic) of these clouds are still too uncertain to afford any definite information in regard to the upper atmosphere, save only its minimum elevation.

Actual knowledge, therefore, of the upper atmosphere consists of but little more than the following few facts:

1. That above 11 kilometers, in middle latitudes, the temperature, while changing more or less from day to day, is nearly constant, so far as known, with respect to elevation.
2. That the humidity, above 11 kilometers, is vanishingly small.
3. That the atmosphere as far up as 70 to 80 kilometers still scatters an appreciable amount of light.

4. That there is some atmosphere, in part hydrogen, at least as high as 150 kilometers.

The experimental and observational knowledge of the upper atmosphere is very limited, but from the few known facts several inferences may be drawn.

Since vertical convection, whenever at all rapid, leads to an approximately adiabatic rate of change of temperature with elevation, and since the temperature of the upper atmosphere is nearly the same at one elevation as at another, it follows that the upper atmosphere is essentially free from vertical convection.

Again, the constant mechanical mixing of the lower atmosphere, due to winds and vertical convection, tends to secure the same volume percentage of its several gases from the surface of the earth up to the beginning of the isothermal region, beyond which level vertical convection does not extend. Absolute constancy in this volume percentage is interfered with in many ways, but in the case of the principal "permanent" gases concerned, nitrogen, oxygen, and argon, essentially through the varying amounts of water vapor, which, owing to change in temperature, rapidly decrease with increase of elevation. Hence the volume percentages of the gases of the atmosphere at the beginning of the isothermal region, say at the 11-kilometer level, are those of a nearly dry atmosphere at the surface of the earth, and therefore in close agreement with the following values [1] for an absolutely dry atmosphere:

Nitrogen	78.03	Hydrogen	0.01
Oxygen	20.99	Neon	0.0015
Argon	0.94	Helium	0.00015
Carbon dioxide	0.03		

Since the average temperature of the isothermal region in middle latitudes is about −55° C., therefore the volume percentage of water vapor at the limit of vertical convection may still amount to 0.01. This must slightly reduce, in proportion to their several volumes, the percentages of all other gases present. Hence nearly four-fifths of the reduction must apply to nitrogen, and therefore its percentage at this level, 11 kilometers, will be taken as 78.02, and all the others as above given.

Above the limit of vertical convection each gas, presumably, will distribute itself as though it alone was present, and hence the volume percentages of the lighter gases probably increase with increase of elevation.

Assuming the surface temperature of the earth to be 11° C., the corresponding height of the barometer 760 mm., and the decrease of temperature with elevation 6° per kilometer, it follows, using Ferrel's formula,[1] that at 11 kilometers the barometer would read 168 mm.

---

[1] Hann, Lehrbuch der Meteorologie, 2d ed., p. 5.

The partial pressure, in millimeters of mercury, of each separate gas at this elevation, 11 kilometers, is obtained by multiplying its respective volume percentage by the total pressure, 168 mm. At greater elevations its corresponding pressures are readily obtained, assuming constancy of temperature, by the equation—

$$-dB=B\frac{dh}{H}$$

in which dh is the change in elevation from any given level, B the height of the barometer (partial pressure) at this level, and H the virtual height of the gas in question; or its height, assuming its density throughout to be the same as at the given level, necessary to produce the partial pressure B.

For convenience in computing the pressure B at the height h from the known pressure B' at the height h' the above equation is put in the form—

$$\text{Log}_{10}B=\text{Log}_{10}B'-\frac{0.434295}{H}(h-h').$$

The partial pressures of Table I were computed by this formula.

TABLE I.—*Pressure in millimeters of mercury of gases of the atmosphere.*

Height in kilometers.	Argon.	Nitrogen.	Water vapor.	Oxygen.	Carbon dioxide.	Hydrogen.	Helium.	Total.
120	....	0.00001	....	....	....	0.00521	0.000024	0.0052
110	....	0.00004	0.000001	....	....	0.00581	0.000030	0.0059
100	....	0.0002	0.000003	0.000007	....	0.00648	0.000038	0.0067
90	....	0.0008	0.000008	0.00004	....	0.00722	0.000047	0.0081
80	....	0.004	0.000020	0.00023	....	0.00804	0.000058	0.0123
70	0.000007	0.017	0.000054	0.0013	....	0.00897	0.000072	0.0274
60	0.00003	0.076	0.00014	0.0072	....	0.00999	0.000090	0.0935
50	0.0005	0.35	0.00038	0.041	0.000005	0.01114	0.00011	0.403
40	0.004	1.59	0.00101	0.232	0.00005	0.01241	0.00014	1.84
30	0.030	7.27	0.00267	1.31	0.00054	0.01384	0.00017	8.63
20	0.241	33.30	0.00707	7.42	0.0059	0.01542	0.00021	40.99
15	0.685	71.30	0.0115	17.63	0.0193	0.01628	0.00024	89.66
11	1.58	131.075	0.017	35.26	0.05	0.017	0.00026	168.00

The rare gases neon, krypton, and xenon are purposely omitted from this table, since it seems improbable that they can exist to any appreciable extent in the upper atmosphere. Ozone, nitric acid, and other compounds that occur in varying small amounts are also omitted, since it is quite probable that in the high atmosphere they form only a small percentage of the total gases present.

The only other substance in the atmosphere that needs to be considered is the dust. This is divisible into three portions: *a*, Volcanic dust, extending at times to great altitudes, but of only occasional importance, as, notably, after the eruption of Krakatoa. *b*, Earth dust, solid particles of various kinds and sources, dry soil, vegetation, smoke, et cetera, carried up by the winds from the surface of the earth; always present, but never rising above the limit of vertical convection. *c*, Meteoric dust, solid particles brought into the atmosphere from outer space. This latter is in the atmosphere in amounts that decrease, above the limits of vertical convection, with increase of elevation, as is evident from the terminal velocity equation[1] applicable to the fall of solid particles in gases,

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[1] Report Chief Signal Officer, 1885, pt. 2, p. 37.

$$V=\frac{2}{9}g\,a^2\,\frac{(\sigma-\rho)}{\mu}(1+A\,\frac{l}{a}),$$

in which $V=$ the terminal velocity, g the acceleration due to gravity, a the radius of the particle (supposed spherical), σ the density of the particle, ρ the density of the medium, μ the viscosity of the medium (independent of pressure), A a constant, and l the free path of a molecule of the medium.

Since, in the upper atmosphere, ρ is always small with respect to σ, and since l is inversely proportional to the pressure, therefore for any given value of a,

$$V=K\,(1+\frac{C}{B}),$$

in which K and C are approximate constants and B the barometric pressure. Hence the velocity of fall must decrease and the number of particles per cubic centimeter (assuming a constant supply) correspondingly increase with increase of pressure. Therefore even the meteoric dust, presumably, is distributed in the upper atmosphere roughly according to the same logarithmic law of decrease with elevation that applies to the permanent gases.

What part of the upper twilight comes from meteoric dust is not known. From Schuster's[2] calculations it would seem to be small, since he finds the light scattering power of the gases alone of the atmosphere sufficient to account for the sky light of exceptionally clear days. Meteoric dust in this connection may therefore be provisionally neglected.

It will be interesting now to consider both the mass density and the light-scattering power of the upper levels of the atmosphere, considering only known gases at the computed pressures given in Table I.

If the temperature is constant with respect to elevation, then both the mass density of each gas and the intensity of its scattered light must vary directly as the corresponding partial pressure. Therefore, numbers approximately proportional to the mass density of the upper atmosphere at different levels may be obtained by adding together the full partial pressures of nitrogen and oxygen and the fourteenth part of that due to hydrogen.

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[1] McKeehan, Phys. Rev. 34, p. 153, 1911.

[2] Nature, v. 81, p. 97, 1909.

Similarly numbers roughly proportional to the light-scattering power of the upper atmosphere at different levels may be obtained by adding together the full partial pressures of nitrogen and oxygen and the fourth part of that due to hydrogen.

The relative mass densities and intensities of scattered light are given in Table II.

The relative quantities of light scattered by a single molecule each of nitrogen, oxygen, and hydrogen are proportional to the corresponding values of $(\mu-1)^2$, in which μ is the refractive index of the gas in question.[1] But the value of $\mu-1$ for nitrogen is roughly the same as for oxygen, and twice the value for hydrogen. Hence in diffusing or scattering light, hydrogen is only about one-fourth as effective as either nitrogen or oxygen.

TABLE II.—*Relative mass-densities of, and light-intensities from, the upper atmosphere.*

Height in kilometers.	Mass density $N+O+\frac{1}{14}H$.	Light intensity $N+O+\frac{1}{4}H$.
120	0.00038	0.00131
110	0.00046	0.00149
100	0.00067	0.00183
90	0.00136	0.00265
80	0.00480	0.00624
70	0.01894	0.02054
60	0.08391	0.08570
50	0.39180	0.39379
40	1.82290	1.82510

Table II is reproduced graphically in figure I, in which the ordinates are elevations in kilometers and the abscissæ proportional to mass density, solid curve; and light intensity, dotted curve.

The abscissæ of the two curves are proportional to the corresponding nitrogen equivalents, and therefore, except in the very high atmosphere, are essentially coincident.

From Table II, and also from figure I, assuming them approximately correct, it appears that both the mass density and the light intensity gradually change with change of elevation, the absolute change growing with increase of elevation, while the percentage change for any given change in elevation remains nearly constant.

Above 75 kilometers, at which level skylight is already very faint, the absolute light intensity soon begins to decrease very slowly with increase of elevation, while below this level it soon rapidly increases with decrease of elevation. Hence an indistinct boundary to twilight phenomena might be expected at about this level—a boundary that must somewhat extend to higher levels or contract to lower with increase and decrease respectively of the transparency of the lower atmosphere.

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[1] Pernter-Exner, Meteorologische Optik, p. 586.

And this is in full accord with observations.[1] Hence it seems probable that the assumptions according to which these tables were computed, absence of vertical convection and constant temperature at −55° C, are approximately correct.

Wegener[2] has considered the possibility of a gas, which he calls geocoronium, in the outer atmosphere, that is even lighter than hydrogen, and therefore at great elevations, 250 kilometers and more, practically the only gas present. As Wegener himself says, the existence of such a gas is highly speculative, with but little other than the green auroral line to give it support.

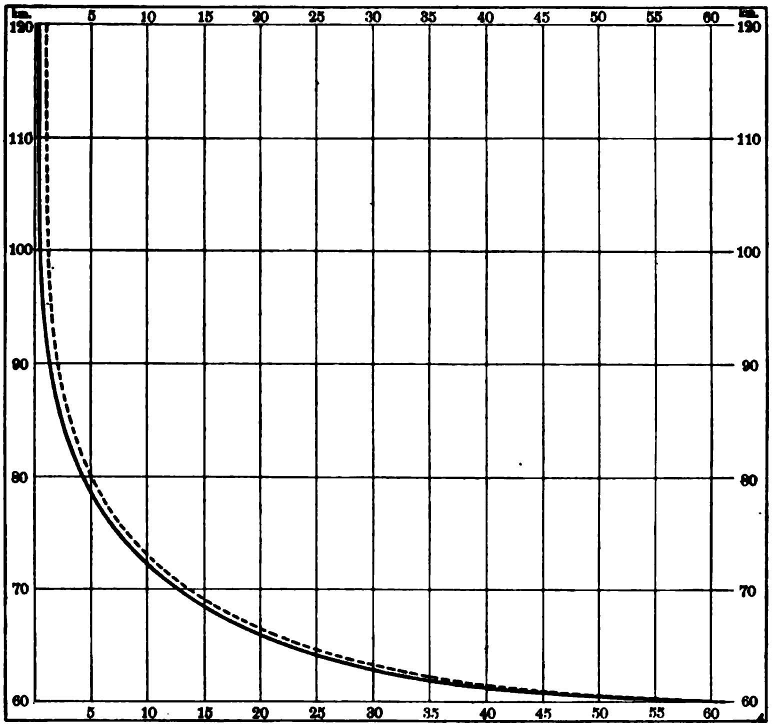

FIG. 1.—Relative mass-density and light-intensity.

While admitting the possible existence of geocoronium, its presence in considerable percentage at great altitudes will not here be included among the probably correct deductions in regard to the upper atmosphere—its presence seems possible but not probable.

CONCLUSION.

To sum up the existing knowledge of the upper atmosphere:

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[1] Pernter-Exner, Meterologische Optik, p. 766.

[2] Phys. Zeit. xii, pp. 170, 214, 1911.

SOURCES OF INFORMATION.

1. Records of sounding balloons.
2. Observations of meteors.
3. Observations of twilight phenomena.
4. Observations of auroras.
5. Observations of noctilucent clouds.

CHIEF FACTS OF OBSERVATION.

1. At and beyond 11 kilometers up to the greatest elevation yet reached, about 30 kilometers, the temperature is substantially constant at any given time and place.

2. The humidity of the upper atmosphere is vanishingly small.

3. The upper atmosphere consists in part of hydrogen and helium.

4. The atmosphere is sufficiently dense at an elevation of 150 kilometers to fire meteors.

5. The atmosphere at 70 kilometers elevation still scatters a perceptible amount of light.

CHIEF INFERENCES.

1. The temperature of the upper atmosphere is substantially constant with respect to elevation far beyond the limits yet reached by sounding balloons.

2. The upper atmosphere is practically free from vertical convection.

3. The volume percentages of the gases at the beginning of the isothermal region are the same as those of dry air at the surface of the earth.

4. Above this level the lighter gases gain in percentage with increase of elevation.

5. Above 75 kilometers, mass-density and light-intensity soon decrease very slowly with increase of elevation, while below this level they soon increase rapidly with decrease of elevation.

6. Above 75 to 80 kilometers dust falls comparatively rapidly, while below this level it settles more and more slowly.

7. There is no level at which either mass-density or light-intensity change in any sense abruptly with change of elevation.

(XXII) ECHELON CLOUDS.

By W. J. Humphreys.

Now and again, in the course of their ceaseless changing, cumulus clouds so gather over level stretches of country, and over the ocean, that they appear like some ancient flight of giant steps, broken and torn by the ruinous hand of time, but still grand and sublime as in that mysterious age when their marble form first came from the hands of master workmen. And fancy whispers softly that these steps lead on and on to a great temple of transcendent size and beauty through whose portals none but the gods ever came and went.

But the purpose of this note is not an aimless ramble through imagination's sweet poppy field, but rather a simple explanation in the disillusioning language of science as to how a lot of fleecy clouds can be so marshaled as to produce so exquisite a sky picture, and what it all means.

The accompanying picture, figure 1, taken by Mr. E. B. Calvert, at Mount Weather, Va., while not a perfect example of the echelon effect, will suffice to illustrate the phenomenon in question, and the schematic drawing, figure 2, will aid in explaining how the stair-step illusion is produced.

Let the vertical distribution of moisture and the vertical temperature gradient be substantially the same at one place as at another over a considerable area, say 50 miles square. Under these conditions the cumulus clouds over this region, if formed by rather gentle convection, will have flatish bases and all the bases will be at substantially the same level, the level at which the adiabatic cooling due to convection from the surface is just sufficient to induce condensation.

The base outline of each individual cumulus will, of course, be more or less irregular, but in general its diameter in one direction will not differ essentially from its diameter in any other. To an observer some distance away, however, and at a lower level, the diameter in the line of sight will appear greatly foreshortened, while the diameter at right angles to this direction will appear in full magnitude. Hence the base of each cloud will seem to be much longer than broad, with the greatest length at right angles to the line of sight, and a large number of such clouds, more or less uniformly distributed, will combine to simulate the underside of a flight of steps or, if one prefers, an inverted flight, with the direction of descent straight away from the observer.

In many cases, particularly over wide valleys, like the one shown in the picture, the cumuli actually are longer than broad and all parallel to each other. This condition, whether due to air billows or to some other cause, produces steps more nearly continuous and heightens the general effect. The clouds under consideration, however, are true cumuli with distinct convection heads, as the picture shows, due, as all cumuli must be, to vertical convection from a much lower level, and are not simple undulation or billow clouds that never have and can not have convection heads. It is true that these latter, especially the larger ones known as "roll cumuli," though they are not cumuli at all in the strict sense of the term, somewhat simulate echelon clouds, but not very closely. Their bottoms are not flat and there is but little contrast in light and shade—two conditions essential to the stair-step effect. Hence they appear as adjacent rolls or billows, and not as a series of flat-bottomed steps.

The exact manner by which the stair-step illusion is brought about is illustrated by figure 2, in which O is the position of the observer, H his horizon, 1, 2, 3, etc., evenly spaced flat-bottomed cumuli.

Since the clouds are at a higher level than the observer, each succeeding cloud, as the distance increases, is seen at a lower angle than its predecessor; and the dark bases of any two adjacent clouds appear to be connected with each other by the lighter side of the farther one. Besides, their general resemblance to stair steps, which, because of our familiarity with them, such a cloud distribution is likely to cause us to think of, leads us into the error of "seeing" the connection between any two bases to be at right angles to both. That is, referring again to figure 2, if we start with the base *a*, the light side of cloud 3 appears as a vertical surface at *b*, and its base as a dark horizontal surface at *c;* the side and base of cloud 4 appear as the next vertical and horizontal surfaces, *d* and *e*, respectively, and so on for the other clouds; the whole effect merging into the seeming horizontal steps *a*, *c*, *e*, etc., connected by the vertical sides *b*, *d*, *f*, etc.

These clouds, grouped in the manner described, also simulate the beautiful rice terraces of the Orient, probably even more closely than a flight of steps, and hence the term "terrace cloud" might appropriately be applied to them. But as comparatively few Europeans and Americans are familiar with rice terraces, while all are familiar with stair steps, the term "echelon" seems preferable, and especially so since it is of international usage.

The meteorological meanings of the cloud phenomena just described are, among others:

a. That the cloud bases are all on about the same level.

b. That the vertical distribution of water vapor is essentially the same over all the region covered by the clouds in question.

c. That the change of temperature with altitude above any given place in this region is substantially the same as it is above any other.

d. That the amount of humidity is rather large.

e. That vertical convection is occurring in many separate places, but nowhere violently.

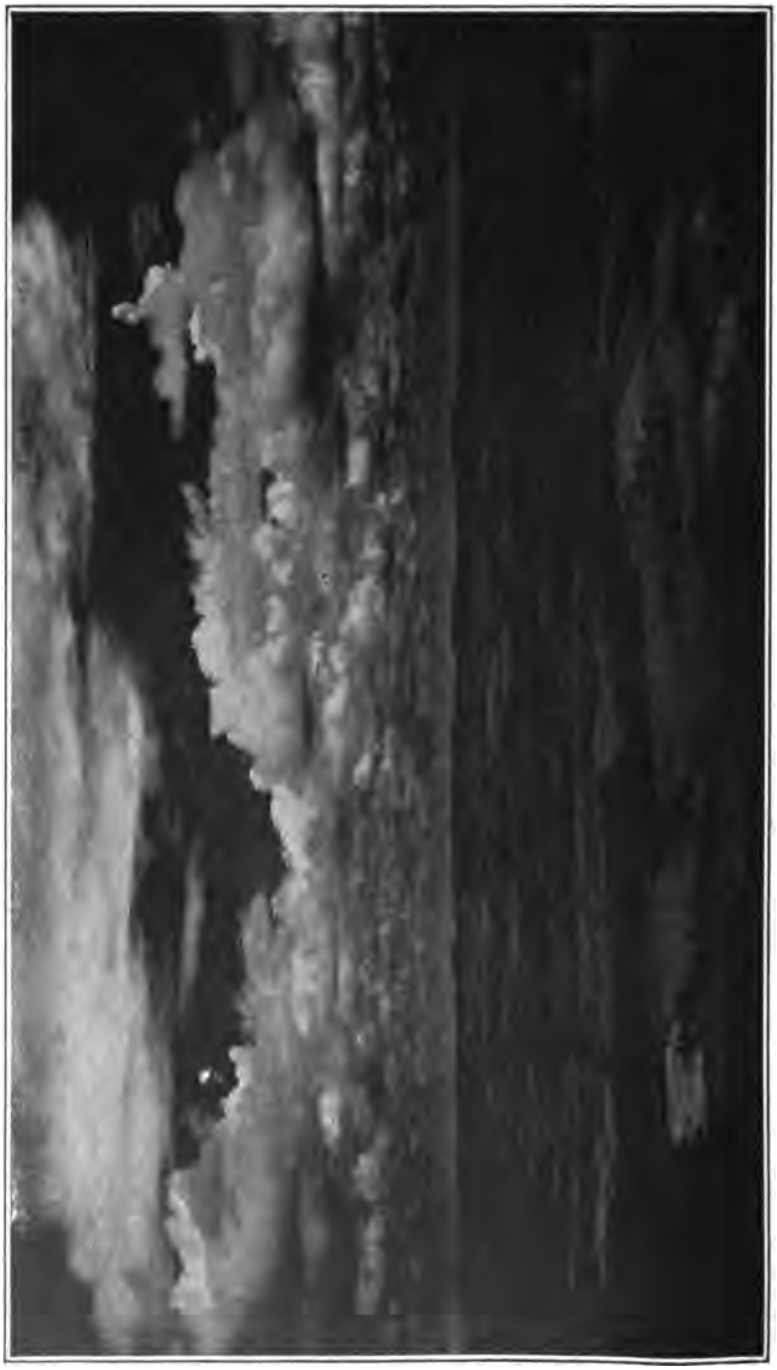

FIG. 1.—Clouds as seen from Mount Weather, Va. Photographed by E. B. Calvert, 15th May, 1904.

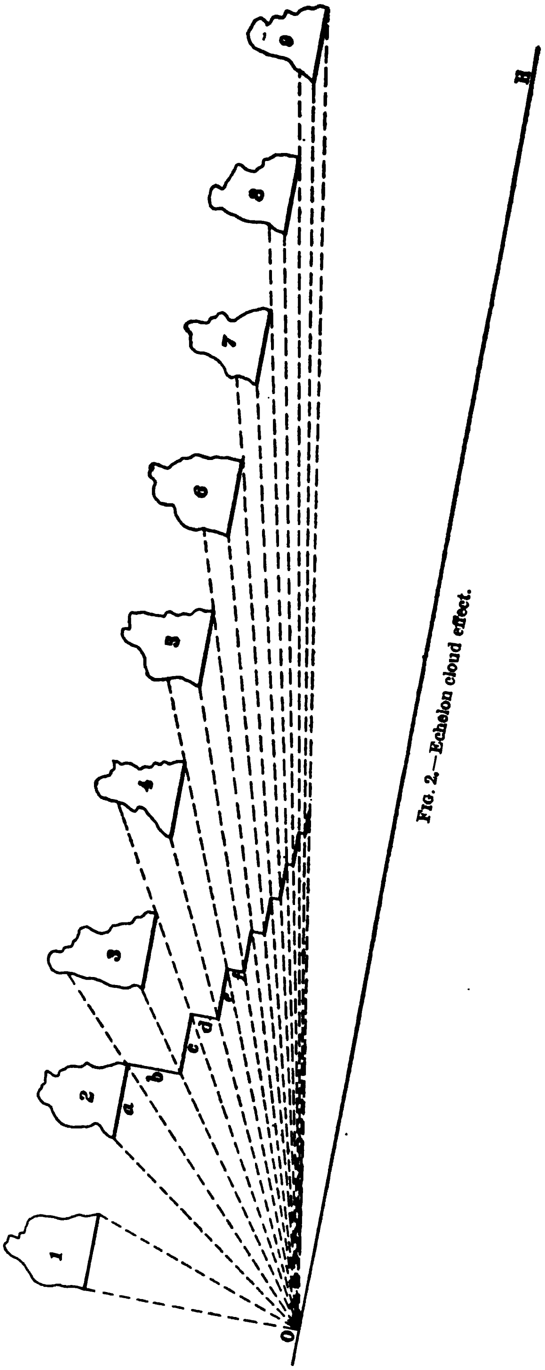

FIG. 2.—Echelon cloud effect.

(XXIII) REVIEW OF BUSCH AND JENSEN "ON THE FACTS AND THEORIES OF ATMOSPHERIC POLARIZATION."[1]

By H. H. KIMBALL.

In summarizing what at present is known of the polarization of sky light, the authors have done a great service to students of meteorological optics. Not only have they given the main facts and theories of atmospheric polarization and of certain allied phenomena, but they have also presented a very complete summary of atmospheric polarization observations, and especially of the observations by those early investigators whose papers are now difficult of access.

In the Introduction, following a statement of the main features of the phenomena, and of the general theories that Soret and Hurion advanced to account for them, it is shown what variations might be expected from theoretical considerations, especially with reference to the positions of the neutral points of Arago and Babinet, and also what variations have actually been observed from year to year. The relation that may exist between these variations and volcanic eruptions, optical phenomena of the atmosphere, and solar activity as revealed to us by sunspots, is also considered, and the need is shown for further investigations to answer some of the questions that arise.

The discussion of these subjects is amplified in the three sections into which the book is divided. Section I, pages 16 to 182, inclusive, treats of the general subject of atmospheric polarization, including some theoretical considerations of the nature of light, and of the principles involved in the construction of polariscopes. Section II, pages 183 to 314, inclusive, treats of the neutral points; while Section III, pages 315 to 512, inclusive, treats of the percentage of polarization of the light from different points of the sky, and also of observations having a close relation to atmospheric polarization, such as measurements of the surface brightness of the sky, the color of the sky, the transparency of the atmosphere to solar radiation, the humidity of the atmosphere, the dust content of the atmosphere, etc.

It appears to be the aim throughout these sections first to present the facts in the form of condensed observational material, and then to correlate these facts with other related observations, and thus to gain an insight into their significance. Sections II and III also give instructions relative to the manner of observing atmospheric polarization.

The significance of certain phases of atmospheric polarization appears to be not yet well understood, but many facts are brought out in the discussion of the observations, such as the marked optical disturbances that occurred in the atmosphere in 1884 to 1886, 1891 to 1893, 1902 to 1904, and 1907 to 1908. These disturbances were made apparent not only through a shifting of the neutral points from their normal positions, and in a diminution in the percentage of polarization of sky light where observations of this latter were available, but also through the twilight and other optical phenomena, as also in a diminution of the intensity of solar radiation at the surface of the earth, due probably to diminished atmospheric transparency.

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[1] Tatsachen und Theorien der atmosphärischen Polarisation nebst Anleitung zu Beobachtungen Verschiedener Art. Zum Gedächtnis hundertjähriger Forschung im Auftrage des PHYSIKALISCHEN STAATSLABORATORIUMS IN HAMBURG und der VEREINIGUNG von FREUNDEN der ASTRONOMIE und KOSMISCHEN PHYSIK herausgegeben von Prof. Friedr. Busch und Dr. Chr. Jensen.—Mit zahlreichen Tabellen und Figuren im Text.—Aus dem JAHRBUCH der HAMBURGISCHEN WISSENSCHAFTLICHEN ANSTALTEN. XXVIII. 1910. (5 Beiheft: Mitteilungen aus dem Physikalischen Staatslaboratorium.) Hamburg 1911.

These various phenomena unite in indicating an increased dustiness of the earth's atmosphere during the years indicated above, perhaps on account of volcanic eruptions.

In addition to these long-period variations in sky polarization there are also variations from day to day that appear to be associated with meteorological conditions. It is especially noted that incipient condensation of atmospheric moisture is accompanied by a diminution in the amount of the polarization of sky light, so that the inauguration of conditions favorable to cloud formation is frequently announced some hours before the first cloud is visible.

The movements of the neutral points when the sun is near the horizon appear to be influenced by the dust-content of the atmosphere, both as regards the amount, and also the size of the particles, and by the density of the atmosphere in which they predominate—whether a surface layer or one at considerable height.

The presence of clouds so modifies the atmospheric polarization that measurements made under cloudy conditions can have little significance, except that a cloud layer below the horizon appears to influence the movements of the neutral points in a systematic manner.

Consideration is also given to the possible effect of variations in the so-called solar constant and the addition to the atmosphere of cosmical dust probably at a variable rate, upon some of the phenomena observed; also to the effect of color and the atmospheric impurities of great cities on the positions of the neutral points, and finally to the relation between the width of the neutral arch and atmospheric conditions.

That the investigations of these authors are already bearing fruit is attested by the fact that in their "Conclusion" they name a goodly number of observers and institutions that have recently undertaken to carry on atmospheric polarization observations in a systematic way. From this organized international effort they hope to obtain results that will advance our knowledge of the meteorological processes taking place in our atmosphere and that will be of value to those that have to do with forecasting weather changes.

Dr. Jensen is ready to assist any one interested in this line of research to obtain a convenient polariscope.

(XXIV) FREE AIR DATA AT MOUNT WEATHER FOR OCTOBER, NOVEMBER, AND DECEMBER, 1911.

By the Aerial Section, WM. R. BLAIR in charge.

In this period of 92 days, 90 free air observations were made, 75 by means of kites and 15 by means of captive balloons. The mean of the highest altitudes reached daily with the kites was 2,917 meters above sea level in October, 2,861 in November, 3,070 in December, and 2,946 in the period. The highest kite flight of the three months, 5,332 meters above sea level, was made on November 23. Nine captive balloon ascensions were made in October, one in November, and five in December. The mean of the highest points reached in these ascensions was 1,740 meters above sea level, while the highest ascension, made October 16, was 2,522 meters above sea level. Balloon ascensions made in the winter months are not only fewer in number but are usually of lower altitude than those made in the summer months. The limit of the height reached in winter ascensions is usually the upper limit of the calm stratum; in the summer ascensions, it is more often the ascensional power of the balloon.

The prevailing surface wind direction was northwest throughout the period. The average wind velocity was 6.7 meters per second in October, 9.6 in November, 7.8 in December. The average velocity in October is about normal, that for November 0.8 higher and that for December about as much lower than the normal. The December kite flights are higher than those obtained by us in any previous December. Those of October and November are lower than those made in these months for either of the past two years.

In the charts, XIX to XXIV, of the free air isotherms, the diurnal range of temperature prominent in charts XIII to XVIII is almost entirely masked by the aperiodic rise and fall of the isotherms in their relation to the surface air pressure. It is to be noted also that, in the period covered by charts XIX to XXIV, a day seldom passes in which one or more inversions in the vertical temperature gradient have not been observed. The October temperatures of 1911 are about 0.3° C. above the five-year means for the month at all levels up to 1,250 meters. At all higher levels, these temperatures are from 1.0° C. to 2.5° C. lower than the 5-year means, the greatest departure being at the 2,000 and 2,500 meter levels. The November temperatures of this year are from 1.0° C. to 3.6° C. lower than the 5-year means at all levels. The greatest departure is found at the 1,250

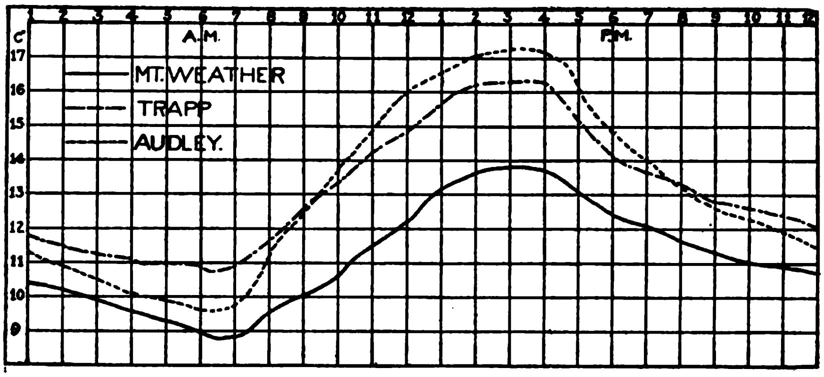

Fig. 15.—Mean hourly temperatures for October, 1911.

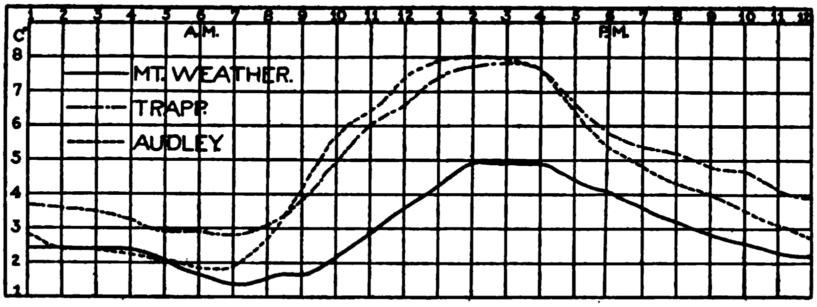

Fig. 16.—Mean hourly temperatures for November, 1911.

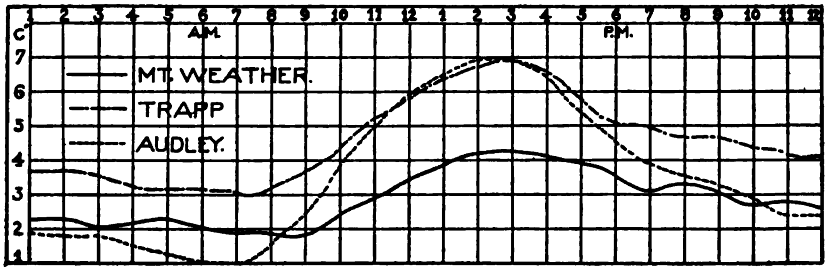

Fig. 17.—Mean hourly temperatures for December, 1911.

meter level. The December, 1911, temperatures are higher than the 5-year means at all levels. The greatest departure, 4.2° C., is found at the 750 and 2,250 meter levels and the smallest, 2.6° C., at the 4,500 meter level. In general, the smaller departures are found at the higher levels. Figs. 15, 16, and 17 show the mean hourly temperatures at Mount Weather, Trapp, and Audley for the three months, and the following table shows the cloudiness for the same period:

Month.	Number of days.			Mean cloudiness in tenths.
	Cloudy.	Partly cloudy.	Clear.	
October	13	10	8	5.9
November	13	9	8	6.0
December	18	7	6	6.8

An attempt has been made during this period to get daily observations of relative humidity and wind velocity. Occasional records of these elements were obtained earlier while the instruments were in process of development. The additional data are tabulated in full under "Results of free air observations." The instruments are still too sluggish to give satisfactory records and further improvement of them will be made if possible.

From the temperature and relative humidity, the absolute humidity in grams per cubic meter has been determined for the two series of ascensions made August 16–17 and September 12–13, 1911, and for the three months of this period. The data for the two 24-hour series have been reduced as were the temperature data for these series, i. e., by the elimination, so far as possible, of changes other than the diurnal, and by smoothing the means. In modifying the mean for any hour, the absolute humidities at the same level of the hours immediately before and after it are considered. Figure 18 shows these smoothed means. Table I shows the diurnal range observed in each series at all levels up to 3.0 kilometers. It also shows the means, smoothed means, and hourly departures from the means for the day at these levels. The greatest departures from the means for the day are found at the 1.5 and the 2.0 kilometer levels. Departures from the mean at the surface, and at the 1.0 kilometer levels are but slightly greater than those at the 2.5 and 3.0 kilometer levels. The maxima and minima of absolute humidity at the different levels seem to precede somewhat the corresponding maxima and minima of temperature; but, in this particular, not too much should be said until more data have been obtained. The levels at which the departures of the absolute humidity from the daily mean are greatest seem to be those at which condensation is taking place in the more local convection currents, i. e., those accompanying the diurnal variation in insolation.

When the absolute humidity for the three months, October, November, and December, 1911, is charted, as the temperatures have been in the charts of the free air isotherms (i. e., lines drawn through points of equal moisture content, time and altitude being the abscissas and ordinates respectively) it is found that the temperature inversions shown in Charts XIX to XXIV occur in regions of high absolute humidity. When the absolute humidities at the different levels reached by the kites are grouped into the four groups, those observed in the front and in the rear of high and of low pressure areas, respectively, it is found that the region in front of a high-pressure area is drier at all levels than any of the other three regions considered; that the air in the rear of a low-pressure area, while frequently moister at the surface and low levels, is usually drier above the 1 kilometer level than that in the rear of a high-pressure area; and that the air in front of a low-pressure area is moister than the air in the rear of a high-pressure area up to the 2.0 or 2.5 kilometer level, but less moist above this level. The data for the three months seem to indicate a seasonal change, higher in the summer months and lower in the winter months, in both the last two levels mentioned. Data for one or more years reduced in this way should prove very interesting.

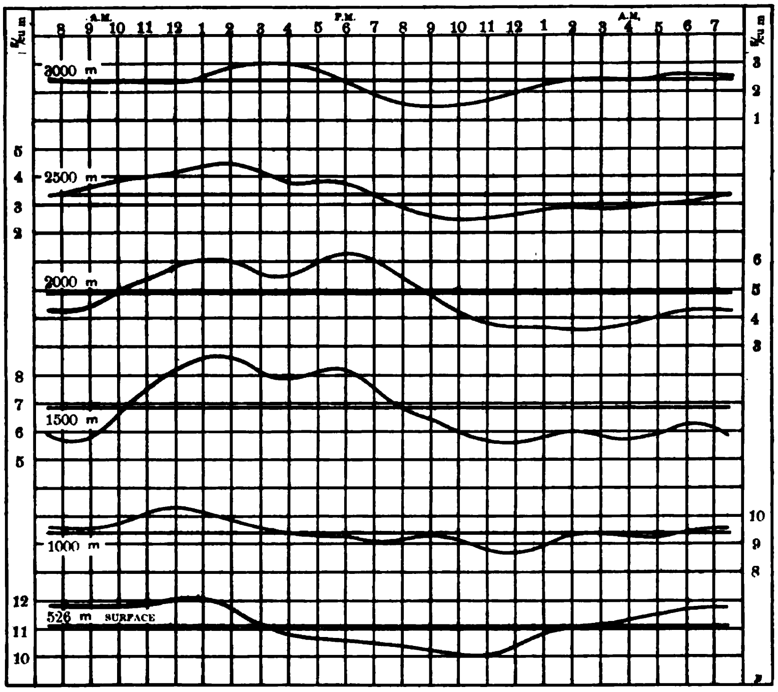

FIG. 18.—The diurnal range in absolute humidity at different levels above Mount Weather, derived from observations made August 16 and 17, September 12 and 13, 1911.

TABLE I.—*The diurnal range in absolute humidity observed in the two*

[Grams per cubic meter.]

Time.	526 m.					1,000 m.					1,500 m.				
	August.	September.	Means.	Smoothed means.	Departures.	August.	September.	Means.	Smoothed means.	Departures.	August.	September.	Means.	Smoothed means.	Departures.
8 a. m.	13.2	10.5	11.8	11.8	+0.7	10.0	8.7	9.4	9.6	+0.2	5.0	5.3	5.2	5.6	−1.2
9 a. m.	13.3	10.5	11.9	11.8	+0.7	10.5	8.8	9.6	9.6	+0.2	3.9	5.6	4.8	5.7	−1.1
10 a. m.	12.5	10.6	11.6	11.8	+0.7	10.8	8.9	9.8	9.8	+0.4	7.9	6.2	7.0	6.5	−0.3
11 a. m.	12.6	11.0	11.8	11.9	+0.8	11.1	9.1	10.1	10.2	+0.8	8.4	6.8	7.6	7.5	+0.7
Noon	13.4	11.4	12.4	12.1	+1.0	11.7	9.4	10.6	10.3	+0.9	7.7	7.9	7.8	8.1	+1.3
1 p. m.	13.0	11.2	12.1	12.0	+0.9	10.4	9.9	10.2	10.2	+0.8	9.5	8.4	9.0	8.6	+1.8
2 p. m.	11.5	11.5	11.5	11.5	+0.4	9.8	10.0	9.9	9.8	+0.4	9.9	8.0	9.0	8.5	+1.7
3 p. m.	9.9	12.0	11.0	11.1	0.0	9.4	9.4	9.4	9.6	+0.2	8.9	5.8	7.4	8.0	+1.2
4 p. m.	10.1	11.4	10.8	10.8	−0.3	9.5	9.2	9.4	9.5	+0.1	8.5	6.6	7.6	7.8	+1.0
5 p. m.	11.3	9.7	10.5	10.7	−0.4	10.1	9.0	9.6	9.3	−0.1	9.9	7.1	8.5	8.1	+1.3
6 p. m.	12.4	9.0	10.7	10.6	−0.5	10.9	7.0	9.0	9.3	−0.1	10.3	6.3	8.3	8.1	+1.3
7 p. m.	12.6	8.4	10.5	10.5	−0.6	11.4	6.9	9.2	9.1	−0.3	10.4	4.5	7.4	7.4	+0.6
8 p. m.	12.8	7.9	10.2	10.4	−0.7	11.5	7.0	9.2	9.3	−0.1	10.2	2.9	6.6	6.8	0.0
9 p. m.	12.8	8.3	10.6	10.2	−0.9	11.3	7.5	9.4	9.3	−0.1	9.8	3.1	6.4	6.4	−0.4
10 p. m.	11.2	8.6	9.9	10.1	−1.0	11.0	7.4	9.2	9.1	−0.3	9.2	3.2	6.2	6.0	−0.8
11 p. m.	11.1	8.6	9.8	10.0	−1.1	10.3	6.8	8.6	8.8	−0.6	8.4	2.2	5.3	5.6	−1.2
M'd't	12.0	8.8	10.4	10.4	−0.7	9.8	7.2	8.5	8.7	−0.7	7.8	2.5	5.2	5.6	−1.2
1 a. m.	12.8	9.2	11.0	10.8	−0.3	10.0	8.1	9.0	9.0	−0.4	7.7	4.8	6.2	5.8	−1.0
2 a. m.	12.4	9.6	11.0	11.0	−0.1	10.9	8.3	9.6	9.4	0.0	7.3	4.9	6.1	6.0	−0.8
3 a. m.	12.2	9.8	11.0	11.1	0.0	10.8	8.2	9.5	9.5	+0.1	6.8	4.7	5.8	5.8	−1.0
4 a. m.	12.4	10.0	11.2	11.3	+0.2	10.5	8.1	9.3	9.3	−0.1	6.7	4.4	5.6	5.7	−1.1
5 a. m.	12.7	10.4	11.6	11.5	+0.4	10.2	8.1	9.2	9.3	−0.1	6.8	4.8	5.8	5.9	−0.9
6 a. m.	13.0	10.5	11.8	11.7	+0.6	10.5	8.3	9.4	9.5	+0.1	7.3	5.6	6.4	6.3	−0.5
7 a. m.	13.0	10.3	11.6	11.7	+0.6	11.0	8.5	9.8	9.6	+0.2	7.1	6.3	6.7	6.1	−0.7
Means.	12.2	10.0	11.1	......	......	10.5	8.3	9.4	......	......	8.2	5.3	6.8	......	......

24-hour series of kite flights, August 16–17 and September 12–13, 1911.

[Grams per cubic meter.]

2,000 m.					2,500 m.					3,000 m.				
August.	September.	Means.	Smoothed means.	Departures.	August.	September.	Means.	Smoothed means.	Departures.	August.	September.	Means.	Smoothed means.	Departures.
4.5	3.5	4.0	4.3	−0.5	3.6	3.2	3.4	3.4	0.0	2.7	2.3	2.5	2.5	+0.1
3.4	5.0	4.2	4.5	−0.3	2.8	4.2	3.5	3.6	+0.2	2.2	2.5	2.4	2.4	0.0
4.7	6.1	5.4	5.1	+0.3	3.2	4.9	4.0	3.9	+0.5	2.1	2.6	2.4	2.4	0.0
4.8	6.3	5.6	5.4	+0.6	3.2	5.1	4.2	4.0	+0.6	2.3	2.6	2.4	2.4	0.0
4.3	6.0	5.2	5.9	+1.1	2.4	5.0	3.7	4.2	+0.8	2.0	2.7	2.4	2.4	0.0
7.5	6.3	6.9	6.1	+1.3	4.5	4.8	4.6	4.4	+1.0	2.4	2.6	2.5	2.7	+0.3
7.3	5.3	6.3	6.0	+1.2	5.4	4.6	5.0	4.5	+1.1	3.9	2.5	3.2	2.9	+0.5
6.0	3.4	4.7	5.5	+0.7	3.2	4.3	3.8	4.1	+0.7	3.7	2.3	3.0	3.1	+0.7
6.3	4.5	5.4	5.5	+0.7	3.6	3.2	3.4	3.8	+0.4	3.9	2.1	3.0	3.0	+0.6
8.2	4.7	6.4	6.1	+1.3	6.1	2.4	4.2	3.9	+0.5	4.5	1.5	3.0	2.8	+0.4
9.2	3.9	6.6	6.4	+1.6	6.0	2.0	4.0	3.8	+0.4	3.8	1.0	2.4	2.4	0.0
9.5	2.9	6.2	5.9	+1.1	5.4	1.2	3.3	3.3	−0.1	3.0	0.6	1.8	1.9	−0.5
9.0	1.0	5.0	5.4	+0.6	4.8	0.6	2.7	2.9	−0.5	2.7	0.4	1.6	1.7	−0.7
8.2	1.6	4.9	4.7	−0.1	4.3	0.9	2.6	2.6	−0.8	2.5	0.7	1.6	1.6	−0.8
6.7	1.9	4.3	4.2	−0.6	3.9	1.2	2.6	2.5	−0.9	2.5	0.9	1.7	1.6	−0.8
5.6	1.4	3.5	3.8	−1.0	3.8	0.9	2.4	2.6	−0.8	2.7	0.6	1.6	1.8	−0.6
5.3	2.1	3.7	3.8	−1.0	4.3	1.1	2.7	2.7	−0.7	3.3	0.7	2.0	2.0	−0.4
5.3	2.9	4.1	3.8	−1.0	4.7	1.5	3.1	2.9	−0.5	3.8	1.1	2.4	2.3	−0.1
4.9	2.3	3.6	3.7	−1.1	4.5	1.5	3.0	2.9	−0.5	3.9	1.1	2.5	2.4	0.0
4.7	2.2	3.4	3.7	−1.1	3.9	1.2	2.6	2.8	−0.6	3.9	1.0	2.4	2.5	+0.1
4.8	3.3	4.0	3.8	−1.0	4.0	1.8	2.9	2.9	−0.5	3.7	1.4	2.6	2.5	+0.1
5.0	3.1	4.0	4.1	−0.7	4.1	2.1	3.1	3.1	−0.8	3.6	1.7	2.6	2.6	+0.2
5.3	3.4	4.4	4.4	−0.4	4.3	2.2	3.2	3.2	−0.2	3.6	1.6	2.6	2.6	+0.2
5.1	4.4	4.8	4.4	−0.4	4.2	2.6	3.4	3.3	−0.1	3.5	1.8	2.6	2.6	+0.2
6.1	3.6	4.8	......	......	4.2	2.6	3.4	......	......	3.2	1.6	2.4	......	......

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. hum.	Wind.		Height.	Pressure.	Temperature.	Rel. hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 1, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.03 a. m....	719.3	9.8	89	se.	7.6	526	719.3	9.8	89	se.	7.6
8.10 a. m....	719.2	10.1	88	se.	8.0	853	691.5	9.9	82	s.	17.6
8.22 a. m....	719.2	10.0	88	se.	8.0	1,336	652.3	8.3	100	ssw.	18.4
8.29 a. m....	719.2	10.3	89	se.	6.7	1,775	619.0	12.1	73	sw.	14.8
8.45 a. m....	719.1	10.3	92	se.	6.3	2,317	580.1	9.5	82	wsw.	15.2
9.00 a. m....	719.0	10.8	89	se.	7.2	2,652	557.0	7.1	94	w.	16.0
9.10 a. m....	718.9	10.6	91	se.	7.2	2,923	538.9	5.7	95	w.	17.8
9.17 a. m....	718.8	10.7	91	se.	8.5	3,197	521.1	4.0	96	w.	17.8
10.10 a. m....	718.4	11.0	91	se.	8.9	526	718.4	11.0	91	se.	8.9
Oct. 2, 1911:											
2.15 p. m....	713.2	13.2	90	nnw.	5.4	526	713.2	13.2	90	nnw.	5.4
2.25 p. m....	713.2	13.0	90	n.	4.9	738	695.4	10.4	......	n.	....
2.55 p. m....	713.3	12.6	89	n.	5.4	1,060	669.0	8.4	......	nnw.	....
3.11 p. m....	713.3	12.7	88	n.	5.8	1,506	634.1	11.4	......	nnw.	....
3.28 p. m....	713.4	13.2	85	n.	5.8	2,470	565.1	10.0	......	wnw.	....
3.42 p. m....	713.4	13.1	85	nnw.	4.5	3,326	509.5	5.8	......	wnw.	....
4.05 p. m....	713.6	13.0	85	n.	5.4	2,672	551.7	9.1	......	wnw.	....
4.11 p. m....	713.6	13.0	85	n.	5.4	2,334	574.5	11.6	......	wnw.	....
4.20 p. m....	713.8	13.0	84	nne.	4.0	1,925	603.3	11.4	......	wnw.	....
4.30 p. m....	713.9	12.8	85	n.	3.6	1,236	655.4	8.3	......	nnw.	....
4.35 p. m....	714.0	12.8	86	nne.	2.2	904	682.3	8.0	......	nne.	....
4.41 p. m....	714.0	12.8	87	nne.	2.2	526	714.0	12.8	87	nne.	2.2
Oct. 3, 1911:											
8.58 a. m.....	720.8	8.2	83	e.	5.4	526	720.8	8.2	83	e.	5.4
9.37 a. m.....	721.0	8.5	84	ese.	5.4	904	688.7	6.3	87	se.	9.6
1.05 p. m.....	720.8	10.4	86	se.	8.9	1,456	643.8	5.1	94	s.	5.7
1.15 p. m.....	720.7	10.5	85	se.	8.9	1,868	612.3	7.4	91	ssw.	7.8
1.35 p. m.....	720.6	10.8	85	se.	8.9	1,502	640.2	5.8	93	s.	8.4
1.55 p. m.....	720.4	11.0	86	se.	8.9	930	686.2	6.9	94	ssc.	14.2
2.16 p. m.....	720.4	10.7	86	se.	8.9	526	720.4	10.7	88	se.	8.9

October 1, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,400 m.

There were 2/10 to 9/10 St.-Cu. from the southwest, altitude, 1,300 m. There were 7/10 to a few A.-Cu., from the west, until 8.30 a. m. After 9.56 a. m. there were about 4/10 St. from the south-southwest.

Pressure was high along the coast from New Hampshire to North Carolina and low over Illinois.

October 2, 1911.—Four kites were used; lifting surface, 25.7 sq. m. Wire out, 4,200 m.; at maximum altitude, 3,900 m.

The sky was covered with St.-Cu., of which the upper stratum moved from the northwest and the lower from the north. The head kite was in St.-Cu. at intervals from 2.27 to 4.34 p. m., at altitudes of 1,150 and 950 m. for the respective strata.

Pressure was low off Rhode Island and relatively low over northern Virginia. High pressure was central north of Lake Superior.

October 3, 1911.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 5,800 m.; at maximum altitude, 4,400 m.

There were 10/10 St. from the south; altitude of base about 1,000 m.

High pressure was central over Vermont; low pressure was central over North Dakota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 4, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
11.20 a. m....	713.6	19.8	83	s.	4.9	526	713.6	19.8	83	s.	4.9
11.37 a. m....	713.3	20.6	80	s.	4.9	1,082	668.8	19.5	73	wsw.	19.6
11.52 a. m....	713.1	20.8	81	s.	4.9	1,640	627.2	14.5	84	w.	26.5
12.10 p. m....	712.9	20.8	81	s.	4.5	2,176	587.9	11.1	88	w.	31.3
12.12 p. m....	712.9	21.0	81	s.	4.5	2,194	586.7	12.0	79	w.	31.3
12.24 p. m....	712.8	21.2	78	s.	4.9	2,756	548.2	8.9	67	w.	32.3
12.40 p. m....	712.7	21.5	80	ssw.	4.0	2,379	573.4	11.1	78	w.	....
12.46 p. m....	712.7	21.6	81	ssw.	4.0	2,362	574.6	8.4	100	w.	....
1.02 p. m....	712.6	21.7	80	s.	4.0	2,120	591.6	10.6	90	w.	31.4
1.22 p. m....	712.3	21.6	79	s.	4.5	1,622	627.2	14.5	86	w.	23.5
1.40 p. m....	712.1	21.7	81	s.	4.9	1,069	668.8	19.0	82	wsw.	17.6
1.54 p. m....	711.9	21.3	81	s.	4.5	526	711.9	21.3	81	s.	4.5
Oct. 5, 1911:											
10.34 a. m....	718.9	11.9	56	nw.	16.8	526	718.9	11.9	56	nw.	16.8
10.45 a. m....	718.9	11.8	54	nw.	13.4	972	681.2	5.0	65	nw.	16.8
10.53 a. m....	718.9	11.9	55	nw.	13.0	1,522	636.5	1.7	67	nnw.	20.6
11.09 a. m....	718.9	12.0	56	nw.	15.2	1,842	612.3	13.4	30	nnw.	15.2
11.37 a. m....	718.9	12.0	56	nw.	13.9	3,024	....	6.3	22	nnw.	18.4
11.57 a. m....	718.9	12.3	55	nw.	13.0	3,543	....	2.2	18	nnw.	18.4
1.25 p. m...	718.6	13.6	53	nw.	12.1	4,552	....	− 4.6	7	nw.	25.2
2.11 p. m...	718.6	13.6	52	nw.	14.3	2,803	....	5.0	6	nw.	9.8
3.10 p. m...	718.8	14.2	55	nw.	8.5	1,523	....	14.6	6	nnw.	13.2
3.16 p. m...	718.8	14.0	53	nw.	9.4	1,051	674.9	5.4	......	nw.	11.6
3.29 p. m...	718.8	13.9	55	nw.	8.0	526	718.8	13.9	55	nw.	8.0

October 4, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out; 4,000 m., at maximum altitude.

There were 2/10 to 7/10 A.-Cu. from the west, and after 12.30 p. m., 3/10 to 6/10 St.-Cu. from the west, altitude, 2,300 m.

Pressure was low north of Lake Superior and high over Georgia and Nebraska.

October 5, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,300 m.

There were 3/10 to 9/10 A.-Cu. and A.-St. from the northwest. A few St.-Cu. from the northwest were visible near the beginning of the flight. 2/10 Ci.-Cu. from the north, during the early part of the flight, had disappeared by about 1 p. m.

Pressure was high over the upper Lake region and a well-developed low was central over the Gulf of St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 6, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.10 a. m.	720.2	7.4	79	ese.	6.3	526	720.2	7.4	79	ese.	6.3
8.32 a. m.	720.1	7.7	77	ese.	7.2	910	687.3	5.7	75	sse.	9.9
9.11 a. m.	719.8	9.0	77	ese.	6.3	1,294	655.5	4.1	73	s.	11.0
9.14 a. m.	719.8	9.0	78	ese.	6.3	1,832	614.2	11.1	53	sw.	11.0
9.18 a. m.	719.7	9.1	78	ese.	5.8	2,205	587.4	11.6	54	w.	17.9
9.24 a. m.	719.6	9.2	74	ese.	6.3	2,624	558.5	7.8	68	wnw.	18.6
9.44 a. m.	719.5	9.6	70	se.	6.7	3,253	517.1	1.8	80	wnw.	24.3
9.56 a. m.	719.3	10.0	69	se.	7.2	3,675	490.5	− 3.0	89	wnw.	23.5
10.05 a. m.	719.3	10.2	71	se.	7.2	3,820	481.5	− 3.1	82	wnw.	27.4
10.17 a. m.	719.0	10.2	73	se.	6.7	4,093	465.4	− 0.6	28	wnw.	....
10.21 a. m.	718.9	10.3	73	se.	7.2	4,170	461.0	− 1.0	24	wnw.	....
10.23 a. m.	718.9	10.3	73	se.	7.2	4,073	466.5	− 0.7	23	wnw.	28.2
10.38 a. m.	718.7	10.8	73	se.	7.6	4,010	470.1	− 2.2	23	wnw.	24.5
11.00 a. m.	718.3	11.7	70	se.	8.0	3,709	488.3	− 1.5	42	wnw.	24.6
11.17 a. m.	718.1	12.4	69	se.	8.0	3,176	521.9	2.8	75	wnw.	23.6
11.39 a. m.	717.8	13.0	69	se.	8.0	2,759	549.0	7.0	72	w.	21.1
11.52 a. m.	717.6	13.2	65	se.	8.5	2,181	588.6	11.4	76	w.	18.3
12.02 p. m.	717.5	13.0	66	se.	9.8	1,869	610.5	14.3	47	sw.	16.9
12.05 p. m.	717.4	12.6	67	se.	9.8	1,629	627.9	14.5	36	ssw.	16.4
12.14 p. m.	717.1	13.0	67	se.	8.5	1,254	656.7	3.8	79	s.	13.3
12.23 p. m.	716.9	13.3	66	sse.	9.4	924	683.5	6.9	79	sse.	11.5
12.27 p. m.	716.8	13.4	65	sse.	9.8	526	716.8	13.4	65	sse.	9.8
Oct. 7, 1911:											
7.06 a. m.	708.3	18.6	84	w.	8.0	526	708.3	18.6	84	w.	8.0
7.14 a. m.	708.4	18.8	83	w.	8.0	1,098	662.7	16.6	84	w.	21.6
7.39 a. m.	708.7	18.9	84	w.	8.9	1,708	617.0	12.1	89	nw.	21.6
7.57 a. m.	709.0	18.8	87	w.	8.9	2,387	568.9	7.0	78	wnw.	23.5
8.06 a. m.	709.1	18.4	89	w.	8.9	2,476	562.8	8.1	72	wnw.	22.5
8.37 a. m.	709.5	18.0	100	nw.	7.2	3,105	520.9	2.6	100	wnw.	32.3
9.05 a. m.	709.8	18.0	100	nnw.	11.6	526	709.8	18.0	100	nnw.	11.6

October 6, 1911.—Four kites were used; lifting surface, 27.2 sq. m. Wire out, 7,000 m.; at maximum altitude, 6,700 m.

There were few to 4/10 Ci. from the west-northwest throughout the flight. A.-Cu. from the west-northwest, altitude 3,500 m., decreased from 7/10 to none by 10.30 a. m., but reappeared about noon and increased to 4/10. Cu. from the south, altitude 1,100 m., appeared about 10 a. m. and increased to 3/10.

High pressure was central over New York, New Jersey, and Pennsylvania and low pressure off Nova Scotia and over northeastern Iowa.

October 7, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,600 m., at maximum altitude.

At the beginning there were 2/10 A.-St. and 8/10 St.-Cu. from the west. Rain began 7.30 a. m. and dense fog began 8.37 a. m. The rain and fog continued intermittently throughout the day.

Pressure was low over northern Virginia and high over the upper Missouri Valley.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 8, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
10.39 a. m....	722.4	8.3	64	e.	4.0	526	722.4	8.3	64	e.	4.0
11.09 a. m....	722.4	8.7	64	e.	3.6	2,423	573.8	8.9	......	nnw.	....
11.16 a. m....	722.4	9.5	66	ese.	2.7	1,963	606.6	7.5	......	w.	....
11.24 a. m....	722.4	9.2	67	e.	2.7	1,889	612.0	9.0	......	sw.	....
11.30 a. m....	722.4	9.6	66	se.	2.7	1,438	646.4	6.2	......	sse.	....
11.41 a. m....	722.4	10.0	63	se.	2.7	1,007	681.4	4.2	......	ese.	....
11.51 a. m....	722.4	10.1	59	se.	2.7	526	722.4	10.1	59	se.	2.7
Oct. 9, 1911:											
1.29 p. m.....	720.4	16.2	52	nw.	3.1	526	720.4	16.2	52	nw.	3.1
1.50 p. m.....	720.4	16.5	57	wnw.	2.7	1,338	654.2	10.9	......	wnw.	....
1.59 p. m.....	720.4	16.0	58	wnw.	2.7	926	687.1	12.6	......	wnw.	....
2.08 p. m.....	720.4	16.6	62	wnw.	2.7	526	720.4	16.6	62	wnw.	2.7
Oct. 10, 1911:											
8.20 a. m....	722.6	11.4	98	se.	5.6	526	722.6	11.4	98	se.	5.6
8.31 a. m....	722.6	11.1	92	ese.	4.9	880	692.7	11.3	86	sse.	10.8
8.47 a. m....	722.7	11.1	97	ese.	5.1	867	694.0	14.0	62	sse.	7.2
10.42 a. m....	722.6	13.4	94	ese.	6.3	1,196	667.3	11.5	67	s.	4.0
10.45 a. m....	722.6	13.5	93	ese.	6.3	975	685.1	12.4	73	s.	4.0
10.52 a. m....	722.6	13.5	93	ese.	6.9	944	687.6	11.4	73	s.	7.9
11.04 a. m....	722.6	13.4	94	ese.	6.7	526	722.6	13.4	94	ese.	6.7

October 8, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were few to 2/10 Ci.-St. from the west-northwest and few Cu. from the southeast.

A large high, with centers over Pennsylvania, eastern Iowa, and Kansas, overlay most of the country. Pressure was relatively low over eastern Tennessee and the Gulf of St. Lawrence.

October 9, 1911.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 1,100 m.

There were 2/10 to 3/10 Ci.-Cu. from the west and a few St.-Cu. from the same direction.

Pressure was high over the Middle Atlantic States and low over the Gulf of St. Lawrence.

October 10, 1911.—Six kites were used; lifting surface, 40.8 sq. m. Wire out, 4,200 m.; at maximum altitude, 1,800 m.

There were 10/10 St. from the east-southeast at the beginning of the flight and 5/10 to 10/10 St. from the southeast from 9.24 a. m. to the end of the flight. 4/10 A.-St. from the north-northwest and 1/10 A.-Cu. of indeterminate direction had disappeared before the end of the flight. Fog from about 8 a. m. until about 9.24 a. m.

High pressure was central over the North Atlantic States and pressure was relatively low over southeastern Kentucky and the Gulf of Mexico.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.
Oct. 11, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
9.46 a. m....	719.2	14.2	98	wnw.	9.8	526	719.2	14.2	98	wnw.	9.8
10.13 a. m....	719.2	15.3	89	wnw.	8.9	879	689.7	11.2	85	nw.	13.7
10.18 a. m....	719.0	15.5	87	wnw.	8.9	1,101	671.8	10.3	63	nw.	22.3
10.30 a. m....	718.9	15.5	83	wnw.	8.9	1,468	642.7	12.3	52	nw.	11.2
11.00 a. m....	718.6	16.2	73	wnw.	10.7	2,028	600.7	8.0	68	w.	10.8
11.53 a. m....	718.2	17.3	69	wnw.	10.3	2,291	581.4	6.3	72	w.	6.1
12.15 p. m....	718.1	17.4	68	wnw.	9.8	1,818	615.4	8.4	53	w.	6.2
12.31 p. m....	717.9	17.3	65	wnw.	10.7	1,650	627.8	10.1	41	w	7.1
12.48 p. m....	717.9	17.8	63	wnw.	10.7	1,504	639.0	8.2	84	wnw.	16.1
1.00 p. m....	717.8	18.0	62	wnw.	10.7	837	692.2	13.1	70	wnw.	12.5
1.07 p. m....	717.8	17.9	61	wnw.	10.7	526	717.8	17.9	61	wnw.	10.7
Oct. 12, 1911:											
8.14 a. m....	715.0	9.9	95	nw.	10.7	526	715.0	9.9	95	nw.	10.7
8.15 a. m....	715.0	9.9	95	nw.	10.7	687	701.4	9.0	93	nw.	20.6
8.16 a. m....	715.0	9.8	95	nw.	10.7	811	691.0	9.3	90	nnw.	20.6
8.27 a. m....	715.0	10.0	95	nw.	10.7	1,074	669.3	6.9	92	n.	18.6
8.44 a. m....	715.1	10.5	93	nw.	11.2	1,172	661.6	8.8	74	n.	11.6
8.58 a. m....	715.2	10.6	92	nw.	11.6	1,604	627.9	7.0	75	n.	9.5
9.27 a. m....	715.2	11.1	89	nw.	11.2	2,134	588.6	1.8	77	n.	7.4
10.02 a. m....	715.3	12.1	85	nw.	8.9	2,658	551.4	− 3.0	81	n.	11.6
10.05 a. m....	715.3	12.4	84	nw.	8.9	2,753	544.3	− 2.4	69	n.	15.1
10.08 a. m....	715.3	12.6	84	nw.	8.9	2,436	565.7	− 1.6	70	n.	9.1
10.10 a. m....	715.3	12.7	83	nw.	8.9	2,272	577.7	− 2.0	73	n.	9.1
10.39 a. m....	715.3	13.0	79	nw.	8.5	2,323	574.1	1.3	63	n.	13.6
10.45 a. m....	715.3	13.1	78	nw.	8.5	2,072	592.2	.9	64	n.	13.2
11.06 a. m....	715.3	13.8	75	nw.	8.9	1,489	636.5	4.0	77	n.	13.7
11.08 a. m....	715.3	13.8	74	nw.	8.9	1,459	639.0	3.6	78	n.	....
11.13 a. m....	715.3	13.8	73	nw.	9.8	1,190	660.3	4.0	87	n.	16.3
11.19 a. m....	715.3	14.0	72	nw.	9.8	986	676.9	6.9	86	n.	15.2
11.27 a. m....	715.3	14.2	71	nw.	8.5	526	715.3	14.2	71	nw.	8.5

October 11, 1911.—Six kites were used; lifting surface, 39.0 sq. m. Wire out, 5,650 m., at maximum altitude.

At 9.35 a. m. there were 6/10 A.-Cu. from the west-northwest and a few St. from the same direction. Both forms gradually disappeared, the former at about 11.00 a. m., and the latter at 10.30. A few Cu. from the west-northwest, noted at 10.27, increased to 4/10 at 1.00 p. m.

An extensive area of high pressure was central over Indiana.

October 12, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 5,900 m.; at maximum altitude, 5,100 m.

St.-Cu. from the north, altitude about 1,100 m., increased from 4/10 to 9/10 by 10 a. m. and decreased to 3/10 by 10.45 a. m. Early in the flight there were a few St. from the northwest at an altitude of 700 m. These gradually rose in altitude and changed in direction to north, reaching the St.-Cu. layer by 9.30 a. m.

Pressure was low over the middle St. Lawrence Valley, with a secondary depression off the coast of North Carolina. High pressure was central over Wisconsin and Lake Superior.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 13, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.01 a. m....	718.1	8.4	90	nw.	9.4	526	718.1	8.4	90	nw.	9.4
8.13 a. m....	718.2	8.6	88	nw.	8.0	1,012	677.0	5.2	53	nnw.	14.7
8.38 a. m....	718.4	8.9	84	nw.	8.0	1,730	620.5	6.2	21	nne.	9.8
9.12 a. m....	718.6	9.1	73	nw.	8.9	2,132	591.1	7.0	16	n.	9.8
10.28 a. m....	718.6	10.1	65	nw.	7.6	2,406	571.8	5.6	16	n.	9.8
10.40 a. m....	718.6	10.4	62	wnw.	6.3	2,842	542.1	2.7	16	n.	10.5
10.52 a. m....	718.6	10.6	65	wnw.	6.7	4,249	454.4	− 5.6	16	nnw.	19.1
12.25 p. m....	718.2	12.0	53	nw.	4.9	4,758	425.4	− 8.6	17	nnw.	....
1.50 p. m....	717.7	13.8	47	w.	4.9	4,025	466.8	− 5.0	10	nnw.	....
2.17 p. m....	717.6	13.7	45	wnw.	4.5	3,158	520.8	− 1.1	14	nnw.	....
2.38 p. m....	717.6	14.0	42	nw.	4.9	2,036	598.4	4.5	14	nnw.	....
2.50 p. m....	717.6	14.0	42	nw.	4.0	526	717.6	14.0	42	nw.	4.0
Oct. 14, 1911:											
6.58 a. m....	718.6	10.2	62	sse.	2.4	526	718.6	10.2	62	sse.	2.4
7.13 a. m....	718.7	10.0	63	sse.	3.6	986	680.1	10.0	67	s.	9.8
7.33 a. m....	718.8	10.2	63	s.	2.5	1,464	642.2	7.1	67	sw.	8.9
8.02 a. m....	719.0	10.6	64	s.	3.4	1,754	619.9	4.0	74	ssw.	8.3
9.16 a. m....	719.2	12.3	59	sse.	1.5	2,250	583.4	4.2	31	ssw.	7.6
9.45 a. m....	719.2	12.4	63	s.	2.9	1,851	612.5	3.2	72	sw.	9.8
9.57 a. m....	719.2	12.6	62	s.	4.2	1,433	644.7	5.3	76	sw.	10.1
10.09 a. m....	719.2	13.1	64	se.	2.2	947	683.9	9.5	65	ssw.	10.3
10.18 a. m....	719.1	13.0	66	se.	2.5	526	719.1	13.0	66	se.	2.5
Oct. 15, 1911:											
1.20 p. m.....	715.3	13.5	93	se.	1.9	526	715.3	13.5	93	se.	1.9
1.39 p. m.....	715.3	14.8	86	ene.	3.1	1,786	615.7	8.1	......	w.	....
1.51 p. m.....	715.3	14.1	91	e.	3.4	931	682.1	13.3	......	wnw.	....
2.05 p. m.....	715.3	13.3	94	e.	3.1	813	691.5	16.0	......	wnw.	....
2.12 p. m.....	715.4	13.4	93	e.	3.1	526	715.4	13.4	93	e.	3.1

October 13, 1911.—Eight kites were used; lifting surface, 50.4 sq. m. Wire out, 7,500 m.; at maximum altitude, 6,900 m.

There were a few Cu., from the north-northwest, until about 10.30 a. m., and a few Ci., from the west-northwest, thereafter.

High pressure was central over Lake Huron, and low pressure south of Newfoundland.

October 14, 1911.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 4,800 m.; at maximum altitude, 2,600 m.

There were 7/10 Ci.-St. and 3/10 to 2/10 A.-St. and A.-Cu. from the west-southwest until about 8 a. m. Ci.-St. had disappeared by 9 a. m. There were 5/10 A.-Cu. and 3/10 A.-St. from the west-southwest at 8.30 a. m., and 9/10 A.-Cu. from the west-southwest from 9.50 a. m. to the end of the flight. A solar halo, which was observed at 7.42 a. m., had disappeared by 9.37 a. m.

High pressure was central over southeastern Pennsylvania, and centers of low pressure overlay the lower Missouri Valley, Alberta, and the Atlantic Ocean directly south of Newfoundland.

October 15, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There was dense fog until 1.29 p. m. From 1.29 p. m. to 2.05 p. m. there were 9/10 to 8/10 St., direction west, and a few A.-St., direction indeterminable. There was dense fog from 2.05 p. m. to the end of the flight. The balloon disappeared in the clouds at 1.48 p. m.

A well developed low had its center over north central Kansas and pressure was moderately high over the South Atlantic States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 16, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
6.19 p.m.....	717.6	13.4	93	se.	4.5	526	717.6	13.4	93	se.	4.5
6.40 p.m.....	717.6	13.1	94	se.	3.6	2,522	565.1	9.6	......	se.	....
6.55 p.m.....	717.6	13.1	94	se.	3.6	1,951	605.3	8.5	......	se.	....
7.00 p.m.....	717.6	12.9	94	se.	3.6	1,340	651.4	[illegible]	......	se.	....
7.05 p.m.....	717.6	12.8	96	se.	4.0	882	688.1	13.5	......	se.	....
7.20 p.m.....	717.6	12.4	98	se.	4.5	526	717.6	12.4	98	se.	4.5
Oct. 18, 1911:											
11.51 a.m....	713.3	14.9	70	nw.	20.6	526	713.3	14.9	70	nw.	20.6
12.01 p.m....	713.3	15.3	68	nw.	17.9	976	....	9.8	73	nw.	21.6
12.17 p.m....	713.4	15.2	66	nw.	18.8	1,180	....	14.3	52	nnw.	9.3
2.00 p.m....	712.2	16.1	66	wnw.	12.1	1,066	....	12.9	52	nw.	9.9
2.08 p.m....	712.1	16.2	65	wnw.	11.6	1,028	....	9.6	70	nw.	15.0
2.22 p.m....	712.0	15.4	67	wnw.	12.5	526	712.0	15.4	67	wnw.	12.5
Oct. 19, 1911:											
11.32 a.m....	714.4	12.8	71	wnw.	16.1	526	714.4	12.8	71	wnw.	16.1
11.34 a.m....	714.4	12.6	73	wnw.	16.1	931	680.7	9.3	83	nw.	14.6
11.47 a.m....	714.2	12.3	78	nw.	16.1	959	678.1	15.7	70	nnw.	7.8
1.08 p.m....	713.9	14.6	71	nw.	9.8	1,463	638.9	12.5	74	nne.	7.8
1.14 p.m....	713.9	14.7	70	nw.	9.8	1,881	608.0	14.5	45	nne.	8.8
1.23 p.m....	713.9	14.9	68	nw.	9.4	2,189	586.2	12.4	36	nne.	7.8
2.09 p.m....	714.1	15.6	70	nw.	8.5	2,576	559.8	....	28	nne.	8.9
2.13 p.m....	714.1	16.0	72	nw.	6.3	2,383	572.9	10.3	28	n.	8.6
2.23 p.m....	714.2	15.8	68	nw.	7.2	1,695	621.6	15.3	28	n.	7.8
2.40 p.m....	714.3	15.5	70	nw.	7.2	1,633	626.5	13.2	28	n.	9.8
2.51 p.m....	714.4	15.5	72	nw.	6.7	1,450	640.2	13.5	52	nnw.	9.8
3.00 p.m....	714.5	15.4	71	nw.	7.2	1,158	662.8	11.1	85	nnw.	11.5
3.05 p.m....	714.6	15.4	72	nw.	7.2	969	678.1	11.2	86	nnw.	9.8
3.14 p.m....	714.8	15.5	72	nw.	7.2	526	714.8	15.5	72	nw.	7.2
Oct. 20, 1911:											
2.22 p.m.....	717.9	14.2	100	e.	3.1	526	717.9	14.2	100	e.	3.1
2.43 p.m.....	717.9	14.2	100	e.	3.6	2,347	578.7	15.8	......	s.	....
3.01 p.m.....	717.9	14.2	100	e.	3.1	1,473	641.9	11.1	......	s.	....
3.10 p.m.....	717.9	14.1	100	e.	3.6	1,000	678.9	15.7	......	sse.	....
3.19 p.m.....	717.9	14.2	100	e.	3.6	745	699.6	13.4	......	e.	....
3.26 p.m.....	717.9	14.2	100	e.	4.0	526	717.9	14.2	100	e.	4.0

October 16, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,100 m.

There were 3/10 Ci. from the west.

Pressure was high over West Virginia and low over Iowa.

October 18, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 4,200 m.; at maximum altitude, 1,800 m.

There were 1/10 to 2/10 St.-Cu. from the northwest. There was light haze toward the close of the flight.

Pressure was high south of Newfoundland and low over the middle and south Atlantic States and over Colorado.

October 19, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 4,100 m.; at maximum altitude, 3,500 m.

There were a few to 9/10 A.-St., direction changing from west to north-northwest, and 2/10 to no A.-Cu. from west-northwest. There were a few to 3/10 Ci.-St. from the northwest between 12.01 and 1.28 p. m.

Pressure was low over the New Jersey coast and north of Lake Superior, and relatively high over West Virginia.

October 20, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,900 m.

There was dense fog.

Pressure was high over Nova Scotia and relatively low over the Ohio Valley.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 21, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
10.14 a. m....	718.4	13.2	100	e.	3.6	526	718.4	13.2	100	e.	3.6
10.28 a. m....	718.3	13.5	100	w.	3.6	2,032	600.7	12.8	......	sse.	....
10.33 a. m....	718.3	13.3	99	w.	3.6	1,982	604.3	14.7	......	s.	....
10.41 a. m....	718.2	13.3	99	w.	2.2	1,684	625.9	12.7	......	s.	....
10.53 a. m....	718.1	13.4	98	nnw.	2.7	1,066	673.6	11.8	......	wsw.	....
10.59 a. m....	718.1	13.4	98	nw.	2.7	949	683.1	15.3	......	nw.	....
11.06 a. m....	718.1	13.6	98	nw.	2.7	633	709.1	12.8	......	nw.	....
11.07 a. m....	718.1	13.6	98	nw.	2.7	526	718.1	13.6	98	nw.	2.7
Oct. 22, 1911:											
10.50 a. m....	714.0	13.9	100	sse.	4.9	526	714.0	13.9	100	sse.	4.9
11.00 a. m....	714.0	13.9	100	sse.	4.9	878	684.8	12.2	100	sse.	17.6
12.40 p. m....	712.3	14.0	100	sse.	8.9	526	712.3	14.0	100	sse.	8.9
Oct. 23, 1911:											
2.16 p. m.....	716.7	11.0	56	wnw.	5.4	526	716.7	11.0	56	wnw.	5.4
2.38 p. m.....	716.7	11.4	55	wnw.	3.6	1,405	644.6	4.6	......	w.	....
2.49 p. m.....	716.7	11.7	54	w.	4.5	1,182	662.3	6.2	......	w.	....
2.58 p. m.....	716.7	12.2	48	wsw.	4.5	878	687.2	8.7	......	w.	....
3.02 p. m.....	716.7	12.0	52	w.	4.5	526	716.7	12.0	52	w.	4.5
Oct. 24, 1911:											
8.04 a. m....	723.6	4.5	73	wnw.	11.2	526	723.6	4.5	73	wnw.	11.2
8.14 a. m....	723.7	5.0	72	wnw.	11.6	1,007	682.0	0.0	85	nw.	14.8
8.35 a. m....	723.8	5.5	72	wnw.	9.4	1,742	622.3	0.5	43	nw.	12.3
8.53 a. m....	724.0	5.3	72	wnw.	15.2	1,941	607.4	5.2	22	nw.	8.8
9.13 a. m....	724.0	5.2	70	wnw.	20.6	2,369	576.3	1.6	......	nw.	5.2
9.16 a. m....	724.0	5.3	70	wnw.	20.6	2,596	560.3	2.2	......	nw.	5.2
11.51 a. m....	724.1	8.6	57	nw.	15.2	526	721.4	8.6	57	nw.	15.2
Oct. 25, 1911:											
10.51 a. m....	726.6	9.2	65	e.	6.7	526	726.6	9.2	65	e.	6.7
11.03 a. m....	726.5	9.2	62	e.	7.2	927	691.9	4.4	57	se.	9.8
11.15 a. m....	726.4	9.2	57	e.	6.3	1,017	684.2	3.5	58	se.	9.2
11.23 a. m....	726.3	9.6	57	e.	6.7	1,338	657.5	1.9	47	se.	7.8
1.40 p. m....	724.6	11.5	53	se.	4.9	1,029	681.7	4.6	65	sse.	7.8
1.48 p. m....	724.5	11.7	50	se.	5.8	756	704.8	6.6	64	sse.	5.8
1.54 p. m....	724.5	12.0	50	se.	5.8	526	724.5	12.0	50	se.	5.8

October 21, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,800 m.

There were 10/10 St. from the northwest and light fog.

Pressure was high off Nova Scotia and low over the Gulf of Mexico.

October 22, 1911.—One kite was used; lifting surface, 6.3 sq. m. Wire out, 600 m., at maximum altitude.

There was dense fog.

Pressure was low over southwestern Ontario and southern Georgia, and high over Newfoundland.

October 23, 1911.—One captive ballon was used; capacity, 22.4 cu. m. Wire out, 1,900 m.

There were few to 2/10 Ci.-St. from the southwest.

Pressure was low over the middle St. Lawrence Valley and the upper Lakes and high over the west Gulf States and Kansas.

October 24, 1911.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 6,000 m.; at maximum altitude, 3,400 m.

The sky was cloudless at 7.45 a. m. There were a few Ci.-St. on the southeastern horizon at 8.21 a. m.; and strong vertical convection currents about 9.00 a. m.

Pressure was high over the Ohio Valley and low over Newfoundland.

October 25, 1911.—Three kites were used; lifting surface, 23.8 sq. m. Wire out, 1,800 m.; at maximum altitude, 1,200 m.

There were 4/10 to 5/10 Ci.-St. and Ci.-Cu. from the west-southwest.

Pressure was high along the north Atlantic coast and low north of Lake Superior.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 26, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.52 a. m....	722.5	9.0	69	w.	4.9	526	722.5	9.0	69	w.	4.9
9.00 a. m....	722.5	9.3	80	w.	4.9	922	688.8	8.7	58	nw.	12.2
9.12 a. m....	722.5	9.7	73	wnw.	3.1	1,314	657.0	6.6	58	nw.	13.7
9.17 a. m....	722.5	10.2	67	wnw.	3.6	1,616	633.4	8.4	35	nw.	12.5
9.42 a. m....	722.6	10.9	58	wnw.	4.9	1,801	619.7	9.1	20	wnw.	11.2
10.07 a. m....	722.6	11.7	59	wnw.	4.9	2,068	600.1	8.2	19	wnw.	9.8
10.55 a. m....	722.4	12.4	57	wnw.	5.4	2,816	547.5	1.8	19	w.	11.7
11.10 a. m....	722.3	13.2	56	wnw.	5.4	3,354	512.3	− 1.4	19	w.	16.7
11.44 a. m....	722.0	13.9	54	wnw.	5.8	4,089	466.7	− 4.4	21	w.	19.6
12.00 m.......	721.9	13.7	52	wnw.	5.8	4,482	444.0	....	21	w.	24.0
12.45 p. m...	721.6	14.7	54	nnw.	6.7	3,750	487.0	− 4.4	22	w.	18.7
12.53 p. m...	721.6	14.8	53	nnw.	5.4	3,620	495.0	− 3.6	22	w.	17.7
1.27 p. m...	721.3	15.0	55	nnw.	5.4	526	721.3	15.0	55	nnw.	5.4
Oct. 27, 1911:											
8.08 a. m....	718.4	12.0	64	wsw.	7.2	526	718.4	12.0	64	wsw.	7.2
8.23 a. m....	718.4	12.3	63	w.	7.2	910	686.2	10.6	58	wnw.	10.8
8.45 a. m....	718.5	12.7	64	w.	6.7	1,467	641.8	6.0	55	wnw.	10.8
9.06 a. m....	718.5	12.8	63	w.	6.3	2,286	580.5	4.2	33	w.	17.6
9.29 a. m....	718.3	13.2	57	w.	5.8	3,138	522.2	− 1.7	23	w.	21.6
10.10 a. m....	718.0	14.0	55	wnw.	6.7	3,877	475.0	− 6.2	12	w.	32.6
10.48 a. m....	717.9	14.5	57	wnw.	5.4	2,719	549.3	1.0	8	wnw.	19.6
11.13 a. m....	717.7	14.4	56	nw.	7.6	2,021	598.6	3.9	8	wnw.	11.8
11.37 a. m....	717.6	14.9	57	wnw.	7.6	1,278	655.6	5.7	36	wnw.	11.9
11.49 a. m....	717.6	15.1	57	nw.	7.6	824	692.6	9.3	48	nw.	9.8
11.55 a. m....	717.5	14.8	56	nw.	7.6	526	717.5	14.8	56	nw.	7.6
Oct. 28, 1911:											
11.55 a. m....	721.4	3.1	79	e.	3.4	526	721.4	3.1	79	e.	3.4
12.18 p. m...	721.3	3.3	78	e.	3.6	1,276	657.1	− 0.9	......	ssw.	....
12.48 p. m...	721.1	3.8	76	e.	3.6	526	721.1	3.8	76	e.	3.6
Oct. 29, 1911:											
9.24 a. m....	719.5	6.4	76	wnw.	3.1	526	719.5	6.4	76	wnw.	3.1
9.30 a. m....	719.5	6.4	73	wnw.	3.1	1,217	661.2	3.7	......	wnw.	....
9.40 a. m....	719.4	6.3	73	wnw.	2.7	844	691.9	4.2	......	wnw.	....
10.22 a. m....	719.4	7.1	71	nw.	3.6	526	719.4	7.1	71	nw.	3.6

October 26, 1911.—Six kites were used; lifting surface 42.7 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,720 m.

There were 4/10 to 7/10 Ci.-St. from the southwest. A few A.-Cu. were visible until 9.00 a. m.; and a solar halo at intervals from 9.42 a. m. to 12.51 p. m.

Low pressure was central over the lower St. Lawrence. High pressure, central over Montana, covered the United States, except the Southwest.

October 27, 1911.—Five kites were used; lifting surface, 32.0 sq. m. Wire out, 7,000 m.; at maximum altitude, 6,700 m.

Ci., from the west-southwest, and A.-Cu., from the west, varied from 6/10 to 2/10. Halo at 11.13 a. m.

High pressure, central over Nebraska, covered the greater part of the United States.

October 28, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 2,000 m.

There were 10/10 A.-St. from the southwest.

An extensive high, with center over northwestern Illinois, covered the entire country with the exception of Florida and the extreme southwest. Pressure was low south of Florida and over the Grand Banks.

October 29, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,700 m.

There were 3/10 to 8/10 A.-Cu. from the west.

Low pressure was central north of Lake Superior. A ridge of high pressure extended from Virginia to Colorado.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Oct. 30, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
6.54 a. m...	719.9	5.6	76	nw.	7.2	526	719.9	5.6	76	nw.	7.2
7.12 a. m...	719.9	5.8	76	nw.	7.6	1,075	673.0	3.4	71	wnw.	17.5
7.30 a. m...	720.0	6.0	73	nw.	7.6	1,325	652.8	6.1	58	w.	7.9
8.52 a. m...	720.4	6.9	68	nw.	5.8	2,021	599.9	3.2	56	wsw.	9.1
9.04 a. m...	720.5	6.9	68	nw.	5.8	2,598	559.1	4.5	39	wsw	20.6
9.15 a. m...	720.5	7.2	67	nw.	4.5	3,763	483.7	− 3.7	55	w.	23.5
9.46 a. m...	720.6	8.2	63	nw.	3.6	4,633	432.2	−10.6	63	w.	26.7
10.28 a. m...	720.6	9.1	59	nw.	4.9	3,845	477.9	− 6.1	72	w.	24.6
10.50 a. m...	720.7	9.6	55	wnw.	3.1	3,388	506.4	− 2.6	72	w.	22.5
11.14 a. m...	720.6	10.3	55	nw.	2.7	2,474	567.4	4.1	68	w.	19.4
11.27 a. m...	720.4	10.3	55	wsw.	2.2	1,681	625.5	2.6	67	wsw.	8.1
11.42 a. m...	720.3	10.2	55	sw.	2.2	1,178	665.4	3.0	66	sw.	12.9
11.51 a. m...	720.2	10.2	55	wnw.	2.2	526	720.2	10.2	55	wnw.	2.2
Oct. 31, 1911:											
7.13 a. m...	717.3	10.0	84	s.	6.7	526	717.3	10.0	84	s.	6.7
7.15 a. m...	717.3	10.2	79	s.	6.7	1,102	669.6	13.0	78	sw.	20.6
7.26 a. m...	717.3	10.4	77	s.	7.2	1,444	643.1	11.7	73	wsw.	15.8
7.55 a. m...	717.3	10.6	81	s.	6.3	1,937	606.0	9.1	72	wsw.	12.5
8.11 a. m...	717.3	11.0	80	s.	5.8	2,881	539.9	0.3	76	wsw.	21.6
8.28 a. m...	717.3	11.3	80	s.	5.4	3,475	501.3	− 4.7	92	sw.	21.6
9.15 a. m...	717.2	13.7	72	s.	3.1	526	717.2	13.7	72	s.	3.1
Nov. 1, 1911:											
8.34 a. m...	716.6	7.6	87	nw.	8.5	526	716.6	7.6	87	nw.	8.5
8.40 a. m...	716.6	7.7	86	nw.	8.9	970	678.9	4.2	88	nw.	18.6
8.55 a. m...	716.7	8.2	85	nw.	8.5	1,392	644.5	0.5	90	nw.	21.6
9.07 a. m...	716.7	8.2	85	nw.	8.5	1,757	615.8	− 2.5	95	nw.	17.9
9.19 a. m...	716.7	8.4	82	nw.	8.9	2,069	592.3	3.6	34	nw.	17.2
9.40 a. m...	716.7	8.4	82	nw.	8.9	3,093	521.7	− 1.6	33	w.	17.6
9.55 a. m...	716.7	8.7	81	nw	7.6	3,680	484.4	− 6.5	50	w.	19.4
10.15 a. m...	716.7	8.8	81	nw.	8.0	4,013	463.9	− 9.6	40	wsw.	23.6
12.04 p. m...	717.1	9.8	68	nw.	12.5	526	717.1	9.8	68	nw.	12.5

October 30, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7,000 m.; at maximum altitude, 6800 m.

There were 4/10 to 6/10 Ci.-St. and Ci.-Cu. from the west-southwest, and a solar halo after 8.30 a. m.

Pressure was high over Virginia and was low southeast of Newfoundland.

October 31, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m. at maximum altitude.

There were 10/10 A.-St. from the southwest. Light rain fell from 7.35 a. m. to 8.05 a. m.

The pressure was low over Lake Erie and high off southern Newfoundland coast.

November 1, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,900 m.

There were 6/10 to 8/10 St.-Cu. from the northwest, altitude 1,200 m., and from the west, altitude 1,700 m.

Pressure was low off the New Jersey coast and high over North Dakota.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.
Nov. 2, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
1.05 p. m.	725.0	0.9	56	wnw.	15.2	526	725.0	0.9	56	wnw.	15.2
1.14 p. m.	725.0	0.5	58	wnw.	13.4	975	685.2	− 4.7	62	wnw.	13.2
1.30 p. m.	725.0	0.9	58	wnw.	14.8	1,719	622.5	−11.8	84	wnw.	17.2
1.43 p. m.	725.1	0.8	57	wnw.	13.0	2,415	568.0	−17.5	86	nw.	19.8
1.55 p. m.	725.1	0.1	67	nnw.	10.3	2,637	551.4	....	80	nw.	17.1
2.19 p. m.	725.6	− 1.6	87	nw.	10.3	2,537	558.5	−17.8	95	nw.	17.1
2.42 p. m.	725.7	− 1.4	90	nw.	9.8	1,993	600.5	−16.0	96	nw.	23.0
3.09 p. m.	725.5	0.2	67	wnw.	13.4	1,644	628.6	−11.7	37	wnw.	26.5
3.28 p. m.	725.6	0.6	60	wnw.	14.3	1,318	656.0	− 9.7	59	wnw.	23.0
3.38 p. m.	725.6	0.8	57	nw.	12.5	965	686.5	− 5.9	69	nw.	20.1
3.54 p. m.	725.7	0.1	58	nw.	11.6	526	725.7	0.1	58	nw.	11.6
Nov. 3, 1911:											
7.59 a. m.	729.0	− 2.8	66	wnw.	7.2	526	729.0	− 2.8	66	wnw.	7.2
8.16 a. m.	729.1	− 2.4	62	wnw.	8.0	905	694.9	− 6.0	65	nw.	15.2
8.22 a. m.	729.1	− 2.2	59	wnw.	8.0	1,434	649.2	− 9.4	68	nw.	14.7
8.39 a. m.	729.1	− 2.1	61	wnw.	8.5	1,770	621.9	− 3.6	51	nw.	10.3
8.49 a. m.	729.2	− 1.9	59	wnw.	8.5	2,072	598.7	− 3.0	39	nw.	7.8
9.13 a. m.	729.2	− 1.2	57	wnw.	8.9	2,567	562.6	− 5.0	34	nw.	8.8
10.02 a. m.	729.1	− 0.4	64	wnw.	9.4	2,819	544.8	− 7.1	32	nw.	10.3
10.45 a. m.	728.8	− 0.1	68	wnw.	10.3	3,176	520.2	− 9.5	32	nw.	11.8
10.52 a. m.	728.7	0.2	53	wnw.	10.7	3,396	505.2	− 9.0	29	nw.	10.1
11.00 a. m.	728.7	0.5	54	wnw.	10.7	3,275	513.4	−11.0	25	nw.	11.8
11.18 a. m.	728.5	0.4	54	wnw.	10.7	2,089	597.5	− 4.1	26	nw.	8.4
11.27 a. m.	728.5	0.8	58	wnw.	9.8	1,775	621.9	− 4.7	34	nnw.	4.1
11.34 a. m.	728.4	1.4	58	wnw.	10.7	1,315	659.2	− 3.9	38	nnw.	8.3
11.40 a. m.	728.4	1.1	56	wnw.	8.0	1,120	675.7	− 6.2	39	nnw.	7.6
11.45 a. m.	728.3	1.0	53	wnw.	8.0	797	703.9	− 3.9	52	nnw.	....
12.00 m.	728.2	1.8	44	wnw.	7.6	526	728.2	1.8	44	wnw.	7.6
Nov. 4, 1911:											
7.45 a. m.	725.1	1.6	45	s.	8.5	526	725.1	1.6	45	s.	8.5
7.56 a. m.	725.1	1.7	44	s.	8.0	915	691.1	3.4	41	sw.	9.8
8.10 a. m.	725.2	1.5	45	s.	6.7	1,608	634.3	1.0	42	sw.	13.2
8.30 a. m.	725.4	2.0	45	s.	7.6	2,122	595.0	− 3.6	52	wsw.	13.0
8.37 a. m.	725.4	1.8	45	s.	7.2	2,431	572.1	− 7.5	51	wsw.	9.8
9.10 a. m.	725.5	2.2	44	s.	6.3	2,784	547.2	− 4.6	97	wsw.	22.7
9.22 a. m.	725.3	2.8	43	s.	6.7	3,532	497.0	− 7.0	98	wsw.	19.6
10.08 a. m.	724.9	2.8	46	sse.	4.9	3,151	521.3	− 6.0	100	wsw.	17.6
10.48 a. m.	724.7	3.3	51	s.	5.8	2,883	538.9	− 5.1	100	sw.	12.8
11.06 a. m.	724.6	3.3	48	s.	5.8	2,484	567.3	− 6.0	100	sw.	18.4
11.26 a. m.	724.4	4.0	47	sse.	8.0	2,105	595.0	− 2.9	64	wsw.	20.9
11.47 a. m.	724.2	4.4	45	sse.	7.6	1,471	644.2	− 0.5	45	sw.	10.4
11.58 a. m.	724.0	4.6	44	sse.	7.2	1,010	682.1	1.9	43	sw.	11.8
12.08 p. m.	723.9	4.6	49	sse.	5.4	526	723.9	4.6	49	sse.	5.4

November 2, 1911.—Four kites were used; lifting surface, 24.3 sq. m. Wire out, 5,000 m.; at maximum altitude, 3,900 m.

St.-Cu. from the west-northwest, altitude 1,500 m., covered 8/10 of the sky until 2.30 p. m., when they decreased to few by 3.15 p. m., and again increased to 6/10 by 3.40 p. m. From 1.30 to 2.30 p. m. they were obscured by 10/10 St. from the northwest, altitude 800 m. Light snow fell from 1.30 to 2.45 p. m., and after 3.42 p. m.

A well-developed high, central over Iowa and Nebraska, covered most of the country. Pressure was relatively low off Nova Scotia.

November 3, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 5,200 m.; at maximum altitude, 4,200 m.

The sky was cloudless.

Pressure was high over the Ohio valley and low off the eastern coast of Newfoundland.

November 4, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7,800 m.; at maximum altitude, 5,000 m.

The sky was covered with St.-Cu. from the west-southwest. Snow fell 8.45 to 9.05, and 9.25 to 9.30 a. m. The head kite entered St.-Cu. at 8.37 a. m., altitude about 2,400 m., and fell below it at 10.40 a. m., altitude about 3,000 m.

High pressure, central off the middle Atlantic coast, covered the eastern United States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Nov. 5, 1911:	*mm.*	*C.*	*%*		*m. p. s.*	*m.*	*mm.*	*C.*	*%*		*m. p. s*
8.23 a. m....	724.2	5.4	72	nw.	5.8	526	724.2	5.4	72	nw.	5.8
8.43 a. m....	724.3	6.0	67	nw.	5.4	929	689.4	4.3	73	nnw.	8.2
9.38 a. m....	724.4	6.3	69	nw.	4.0	1,281	660.2	1.5	79	nw.	7.0
9.53 a. m....	724.4	6.3	68	nw.	2.9	914	690.7	3.1	79	nw.	8.8
10.00 a. m....	724.4	6.5	70	n.	2.8	526	724.4	6.5	70	n.	2.8
Nov. 7, 1911:											
First flight—											
8.25 a. m....	710.0	11.0	54	wsw.	6.3	526	710.0	11.0	54	wsw.	6.3
8.33 a. m....	710.1	11.4	53	wsw.	6.3	1,029	668.4	8.0	51	wsw.	16.6
8.48 a. m....	710.1	12.0	50	sw.	6.7	1,914	599.6	0.3	60	wsw.	31.4
8.54 a. m....	710.1	12.5	46	sw.	7.2	2,079	587.4	1.0	44	wsw.	....
9.05 a. m....	710.1	12.8	44	sw.	8.5	1,965	595.9	0.4	54	wsw.	....
9.32 a. m....	709.8	13.6	40	sw.	10.7	1,426	636.8	4.0	54	wsw.	19.5
9.46 a. m....	709.7	13.8	40	sw.	9.8	1,011	669.7	8.3	46	sw.	14.8
9.57 a. m....	709.6	14.1	40	sw.	8.9	526	709.6	14.1	40	sw.	8.9
Second flight—											
10.30 a. m....	709.4	14.8	39	sw.	6.3	526	709.4	14.8	39	sw.	6.3
10.35 a. m....	709.4	14.9	40	sw.	5.4	854	682.3	11.3	37	wsw.	13.3
10.43 a. m....	709.4	15.0	41	sw.	9.4	1,269	649.1	7.6	58	wsw.	17.2
11.25 a. m....	709.0	15.4	38	w.	17.0	1,877	601.9	0.2	83	w.	29.4
12.15 p. m....	708.6	15.3	33	wnw.	17.9	1,323	644.1	6.0	41	w.	24.9
12.27 p. m....	708.6	14.8	30	w.	22.4	924	675.8	10.7	34	w.	26.5
12.39 p. m....	708.6	15.0	31	w.	16.5	526	708.6	15.0	31	w.	16.5
Nov. 8, 1911:											
7.48 a. m....	716.2	3.2	69	wnw.	8.5	526	716.2	3.2	69	wnw.	8.5
8.00 a. m....	716.3	3.2	69	wnw.	8.5	938	680.6	−0.2	82	wnw.	14.0
8.10 a. m....	716.3	3.2	69	wnw.	9.8	1,197	658.9	−1.5	86	wnw.	15.5
8.14 a. m....	716.3	3.2	69	wnw.	9.4	1,461	637.6	2.0	56	wnw.	14.2
8.27 a. m....	716.3	3.4	69	wnw.	8.5	1,733	616.5	0.7	39	wnw.	13.7
8.40 a. m....	716.3	3.5	68	wnw.	8.0	2,330	572.6	4.2	28	wnw.	16.6
8.56 a. m....	716.3	3.7	67	wnw.	10.3	2,819	539.3	1.8	22	wnw.	16.2
9.33 a. m....	716.5	4.4	64	wnw.	8.9	3,693	483.5	−4.4	13	w.	18.9
10.14 a. m....	716.6	4.8	62	wnw.	8.9	4,397	441.4	−9.2	7	w.	29.4
10.52 a. m....	716.5	5.0	62	wnw.	8.9	3,529	492.5	−5.6	6	w.	....
11.03 a. m....	716.5	5.2	62	wnw.	7.6	3,309	506.4	−3.9	5	w.	18.8
11.29 a. m....	716.4	4.9	61	wnw.	8.0	2,307	573.8	2.6	5	w.	9.8
11.41 a. m....	716.4	5.1	59	wnw.	6.7	1,258	656.4	−2.2	7	wnw.	5.3
11.46 a. m....	716.3	5.0	59	wnw.	8.5	864	687.0	−0.1	21	wnw.	6.8
11.48 a. m ...	716.3	5.0	59	wnw.	8.5	526	716.3	5.0	59	wnw.	8.5

November 5, 1911.—Three kites were used; lifting surface, 21.4 sq. m. Wire out, 1,800 m.; at maximum altitude, 1,600 m.

There were 10/10 to 6/10 A.-Cu. until 8.50 a. m.; direction varied from west-northwest to west. After 8.50 a. m. there were 10/10 A.-Cu. and A.-St. from the west.

High pressure, central over New York, covered the eastern half of the country.

November 7, 1911.—First flight: Two kites were used; lifting surface, 12.6 sq. m. Wire out, 2,500 m., at maximum altitude.

There were 3/10 to 5/10 A.-Cu. from the west.

Second flight: Two kites were used; lifting surface, 10.8 sq. m. Wire out, 3,150 m., at maximum altitude.

There were 3/10 to 1/10 Cu. from the west and after 12.27 p. m., a few A.-Cu. from the west.

Pressure was low north of Lake Huron and high over Kansas.

November 8, 1911.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 6,550 m.; at maximum altitude, 6,100 m.

There were 10/10 Ci.-St. from the west throughout the flight. A few A.-Cu. appeared about 9.50 a. m., but soon disappeared. There was a solar halo after 8.40 a. m.

Pressure was high over the upper Ohio Valley and low over southern Louisiana and the lower St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Nov. 10, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
2.27 p. m....	720.3	15.9	65	ese.	2.2	526	720.3	15.9	65	ese.	2.2
2.31 p. m....	720.4	16.0	70	se.	3.0	1,286	658.2	10.2	......	wnw.	....
2.44 p. m....	720.4	15.1	74	se.	2.4	834	694.6	12.6	......	wnw.	....
3.05 p. m....	720.5	16.2	70	ese.	1.4	526	720.5	16.2	70	ese.	1.4
Nov. 11, 1911:											
7.58 a. m....	721.3	11.0	87	s.	9.8	526	721.3	11.0	87	s.	9.8
7.59 a. m....	721.3	11.0	87	s.	9.8	710	705.7	12.2	87	s.	....
8.12 a. m....	721.3	11.0	87	s.	9.8	1,261	660.9	12.9	50	ssw.	20.1
8.24 a. m....	721.2	11.2	87	s.	11.2	1,667	629.6	11.0	59	ssw.	15.7
8.46 a. m....	721.1	11.5	85	s.	10.3	2,879	543.7	4.2	52	wsw.	17.7
8.49 a. m....	721.1	11.4	85	s.	11.6	3,182	523.7	4.0	49	wsw.	20.2
8.59 a. m....	721.1	11.7	81	s.	11.2	3,550	500.5	0.8	34	wsw.	27.9
9.23 a. m....	721.1	11.9	81	s.	13.4	4,031	470.8	−2.4	25	wsw.	28.6
9.56 a. m....	721.0	12.2	80	s.	13.4	3,462	505.2	−0.8	24	wsw.	24.5
10.11 a. m....	720.9	12.5	80	s.	10.7	3,011	534.3	1.5	27	wsw.	18.6
10.12 a. m....	720.9	12.5	80	s.	10.7	2,924	540.1	1.1	29	wsw.	18.6
10.28 a. m....	720.7	13.0	78	s.	12.5	2,502	568.7	4.6	52	wsw.	16.6
10.35 a. m....	720.6	13.3	76	s.	13.9	2,027	602.5	8.2	48	sw.	16.1
10.45 a. m....	720.4	13.4	73	s.	12.5	1,658	629.6	11.8	53	sw.	14.7
10.53 a. m....	720.3	13.7	74	sse.	13.4	1,203	664.6	12.8	53	ssw.	21.8
10.57 a. m....	720.3	13.9	73	sse.	14.3	1,011	679.9	11.4	61	s.	24.0
11.02 a. m....	720.3	14.2	70	sse.	14.8	526	720.3	14.2	70	sse.	14.8
Nov. 12, 1911:											
5.11 p. m....	710.1	1.4	72	wnw.	22.4	526	710.1	1.4	72	wnw.	22.4
5.21 p. m....	710.2	1.4	71	wnw.	21.5	975	671.2	− 4.4	73	wnw.	18.4
5.47 p. m....	710.4	0.2	74	wnw.	18.8	1,376	637.6	− 7.5	72	w.	27.1
6.15 p. m....	710.5	−1.2	75	wnw.	17.9	1,302	643.5	−11.0	93	w.	31.7
6.40 p. m....	710.7	−2.4	75	wnw.	17.9	526	710.7	− 2.4	75	wnw.	17.9
Nov. 13, 1911:											
10.07 a. m....	722.8	−8.6	59	wnw.	11.6	526	722.8	− 8.6	59	wnw.	11.6
10.14 a. m....	722.8	−8.4	58	wnw.	11.2	827	695.1	−13.9	60	nw.	16.0
10.29 a. m....	722.8	−7.8	59	wnw.	10.3	1,274	655.1	−16.1	64	nw.	16.0
10.40 a. m....	722.7	−7.8	59	wnw.	8.9	1,824	609.1	−14.9	65	nnw.	....
10.48 a. m....	722.7	−7.5	53	wnw.	13.4	2,211	579.3	− 6.5	65	nw.	....
12.07 p. m...	722.6	−6.6	51	wnw.	8.9	526	722.6	− 6.6	51	wnw.	8.9

November 10, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,500 m.

There were a few St.-Cu. from the west and a few Ci. and Ci.-St. from the west-northwest.

High pressure was central over the Gulf of St. Lawrence and pressure was low north of Lake Superior. There was a slight depression off the Rhode Island coast.

November 11, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 6,500 m.; at maximum altitude, 6,300 m.

There were a few A.-Cu. from the west.

A trough of low pressure extended from Wisconsin to New Mexico. High pressure was central over eastern North Carolina.

November 12, 1911.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 2,200 m.; at maximum altitude, 2,000 m.

A.-St. from the west decreased from 8/10 to 5/10 during the flight.

Pressure was high over Oklahoma and very low north of Lake Huron.

November 13, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 3,500 m., at maximum altitude.

There were 3/10 to 4/10 Ci.-Cu. and a few Cu., all from the northwest.

Pressure was low over the Gulf of St. Lawrence. A ridge of high pressure extended from Indiana to Texas.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Nov. 14, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.15 a. m....	722.9	−7.2	84	se.	10.7	526	722.9	−7.2	84	se.	10.7
8.18 a. m....	722.9	−6.8	78	se.	13.4	903	689.0	−4.2	82	ssw.	17.6
8.26 a. m....	722.9	−6.7	76	se.	13.4	1,060	675.4	0.3	72	ssw.	18.1
8.40 a. m....	722.8	−6.5	70	se.	13.4	1,470	641.6	−2.2	65	sw.	18.6
8.48 a. m....	722.8	−6.4	68	se.	11.6	1,798	615.9	1.2	64	sw.	17.6
8.57 a. m....	722.8	−6.4	68	se.	12.1	2,010	599.9	2.9	64	sw.	18.0
9.04 a. m....	722.8	−6.4	68	se.	15.2	2,424	570.0	0.9	64	sw.	18.4
9.20 a. m....	722.6	−6.3	68	se.	13.4	2,868	539.1	−1.0	65	wsw.	20.0
9.42 a. m....	722.3	−5.7	58	se.	11.2	3,476	499.2	−4.5	65	wsw.	30.0
10.25 a. m....	721.9	−3.7	70	se.	11.6	3,036	527.6	−1.8	65	wsw.	18.4
10.41 a. m....	721.7	−3.6	72	se.	13.4	2,738	547.5	−0.5	65	sw.	20.2
10.55 a. m....	721.5	−3.6	73	se.	12.5	2,428	569.0	1.7	64	sw.	18.4
11.21 a. m....	721.2	−3.6	65	se.	15.2	1,844	611.3	2.0	62	sw.	17.6
11.30 a. m....	721.1	−3.8	65	se.	15.2	1,631	627.5	2.7	62	ssw.	23.4
11.37 a. m....	721.0	−3.8	68	se.	14.8	1,242	658.3	0.6	59	ssw.	21.0
11.47 a. m....	720.9	−3.5	66	se.	15.2	895	687.8	−6.8	59	ssw.	19.1
12.00 m......	720.7	−3.5	66	se.	11.6	526	720.7	−3.5	66	se.	11.6
Nov. 15, 1911:											
7.59 a. m.....	707.3	1.2	91	wnw.	13.4	526	707.3	1.2	91	wnw.	13.4
8.00 a. m.....	707.3	1.2	91	wnw.	13.4	607	700.2	3.2	91	wnw.	20.9
8.08 a. m.....	707.3	1.0	93	wnw.	13.4	993	667.4	0.5	67	nw.	24.0
8.16 a. m.....	707.2	1.4	88	wnw.	10.7	1,217	649.0	−1.3	78	nw.	24.0
8.33 a. m.....	707.2	2.4	80	wnw.	16.1	1,548	622.7	−2.1	80	nw.	29.6
8.38 a. m.....	707.2	2.6	78	wnw.	20.1	1,916	594.8	2.2	......	nw.	32.9
8.42 a. m.....	707.2	2.8	75	wnw.	20.6	2,398	560.2	0.4	33	wnw.	32.6
8.49 a. m.....	707.1	2.6	75	wnw.	14.8	2,085	582.4	0.8	18	wnw.	....
9.54 a. m.....	707.9	3.3	74	wnw.	7.6	526	707.9	3.3	74	wnw.	7.6
Nov. 16, 1911:											
10.05 a. m....	717.8	−0.6	61	nw.	13.4	526	717.8	−0.6	61	nw.	13.4
10.10 a. m....	717.8	−0.7	61	nw.	13.9	977	678.1	−6.3	66	wnw.	16.8
10.18 a. m....	717.8	−0.6	61	nw.	14.3	1,432	639.6	−9.1	67	wnw.	24.8
10.33 a. m....	717.8	−0.6	57	nw.	15.2	1,994	595.0	−6.4	44	nw.	31.2
10.45 a. m....	717.8	−0.4	58	nw.	12.5	2,512	557.0	−4.6	36	wnw.	32.0
10.54 a. m....	717.8	−0.2	56	nw.	11.6	2,684	545.2	−1.1	30	wnw.	36.2
11.01 a. m....	717.8	−0.3	53	nw.	15.6	2,998	524.5	−1.5	29	wnw.	38.4
11.24 a. m....	718.1	−0.2	54	nw.	13.4	2,747	542.0	−0.5	......	wnw.	34.3
11.28 a. m....	718.2	−0.2	54	nw.	12.1	2,351	569.7	−4.1	......	wnw.	....
12.00 m......	718.6	0.3	49	nw.	14.3	1,662	622.1	−3.0	......	nw.	....
12.29 p. m...	718.6	0.6	48	nw.	16.1	1,286	652.6	−7.8	30	nw.	17.9
12.37 p. m...	718.6	0.6	49	nw.	14.3	902	685.5	−5.0	35	nw.	16.8
12.45 p. m...	718.6	0.8	48	nw.	11.2	526	718.6	0.8	48	nw.	11.2

November 14, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,400 m.; at maximum altitude, 5,300 m.

There were 10/10 A.-St. from the west-southwest at the beginning of the flight. They gradually decreased to 3/10 at 10.15 a. m. and then increased to 10/10 at the end. At 10.15 there were 5/10 Ci.-St. of an indeterminable direction and 2/10 A.-Cu. from the west-southwest. Both forms were gradually hidden by the A-St.

High pressure, central over the middle Atlantic coast, covered the eastern United States. Pressure was low over Nebraska.

November 15, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4,000 m.; at maximum altitude, 3,800 m.

Ci.-St., Ci.-Cu. and A.-Cu., from the west-southwest, increased from 2/10 to 7/10.

Pressure was low off the New England coast and high over the Gulf States.

November 16, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 6,000 m., at maximum altitude.

There were a few Cu. from the west-northwest.

Pressure was high over Indiana and low over the Gulf of St. Lawrence.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Nov. 17, 1911:											
First flight—	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.02 a. m.....	720.6	−2.6	74	sse.	8.9	526	720.6	−2.6	74	sse.	8.9
8.10 a. m.....	720.5	−2.3	71	se.	....	956	682.8	2.0	......	ssw.	....
8.28 a. m.....	720.4	−1.8	69	se.	9.8	1,647	627.6	8.3	......	sw.	....
8.31 a. m.....	720.4	−1.8	69	ese.	9.4	1,968	603.5	7.0	......	wsw.	....
8.36 a. m.....	720.4	−1.7	69	ese.	9.4	526	720.4	−1.7	69	ese.	9.4
Second flight—											
1.38 p. m....	716.2	1.7	61	se.	13.0	526	716.2	1.7	61	se.	13.0
1.41 p. m....	716.2	1.7	62	se.	10.7	831	689.5	−1.6	......	sse.	15.4
1.46 p. m....	716.1	2.0	60	sse.	....	1,110	665.9	4.9	......	ssw.	30.7
1.50 p. m....	716.0	2.2	59	se.	11.2	1,514	633.6	1.9	......	wsw.	25.1
1.56 p. m....	715.9	2.4	58	se.	11.2	1,544	631.2	4.8	......	wsw.	27.2
2.03 p. m....	715.9	2.4	59	se.	....	1,988	597.7	3.2	......	wsw.	31.6
2.08 p. m....	715.8	2.5	60	se.	8.9	2,247	578.9	5.3	......	wsw.	30.8
2.32 p. m....	715.6	2.6	62	se.	13.0	2,513	560.3	3.9	......	wsw.	23.6
3.24 p. m....	714.8	2.7	63	se.	13.4	2,817	538.9	0.6	......	wsw.	23.3
3.34 p. m....	714.7	2.6	64	se.	11.2	2,436	564.7	3.7	......	sw.	23.3
5.32 p. m....	713.2	2.5	63	sse.	13.0	526	713.2	2.5	63	sse.	13.0
Nov. 18, 1911:											
9.04 a. m....	700.4	6.8	75	wnw.	14.3	526	700.4	6.8	75	wnw.	14.3
9.12 a. m....	700.5	6.3	73	wnw.	15.6	878	670.8	1.7	86	wnw.	23.0
9.30 a. m....	700.6	5.8	72	wnw.	24.1	1,294	637.0	−2.0	85	w.	21.2
9.46 a. m....	700.6	5.2	71	wnw.	23.7	1,681	606.6	−3.7	58	wnw.	31.2
9.49 a. m....	700.6	5.0	70	wnw.	23.7	1,776	599.2	−0.5	36	wnw.	34.9
10.02 a. m....	700.7	4.4	68	wnw.	21.5	1,912	589.3	−1.0	18	wnw.	30.8
10.25 a. m....	700.8	5.2	67	wnw.	22.4	1,572	615.1	1.4	9	wnw.	32.6
10.42 a.m....	700.9	5.3	63	wnw.	23.2	1,220	642.9	−4.0	69	wnw.	27.2
10.57 a. m....	701.0	5.2	62	wnw.	18.3	895	669.7	−0.2	71	wnw.	23.0
11.05 a. m....	701.0	5.4	62	wnw.	16.5	526	701.0	5.4	62	wnw.	16.5
Nov. 19, 1911:											
9.03 a. m....	708.0	2.7	45	w.	11.6	526	708.0	2.7	45	w.	11.6
9.12 a. m....	708.1	3.0	45	w.	11.2	1,003	667.1	− 2.9	47	w.	18.9
9.48 a. m....	708.2	3.4	38	w.	11.6	1,615	617.2	− 8.3	56	w.	23.9
10.07 a. m....	708.3	3.7	42	w.	19.7	2,428	555.5	−12.6	58	w.	30.2
10.26 a. m....	708.3	4.1	43	w.	19.7	3,308	494.5	−17.9	55	w.	29.6
10.27 a. m....	708.3	4.1	43	w.	19.7	526	708.3	4.1	43	w.	19.7

November 17, 1911.—First flight. Three kites were used; lifting surface, 18.9 sq. m. Wire out 2,100 m. at maximum altitude.

There were 5/10 to 8/10 Ci. and Ci.-St. from the west.

Second flight. Five kites were used; lifting surface, 31.5 sq. m. Wire out, 7,000 m.; at maximum altitude, 6,750 m.

There were 10/10 A.-St. and A.-Cu. from the west-northwest and light haze throughout the flight.

Two well developed lows had their centers over eastern Iowa and over Newfoundland respectively. A crest of high pressure extended from off the North Carolina coast to the upper St. Lawrence Valley.

November 18, 1911.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 3,100 m., at maximum altitude.

A.-Cu., from the west-southwest, diminished from 7/10 to few by 9.15 a. m. and to none by 10.45 a. m. Few Ci., from the west, appeared about 10 a. m. Throughout the flight there were 2/10 St.-Cu. from the west-northwest at an altitude of 1,300 m.

Pressure was low north of Lake Huron and high over southern Texas; it was also high at a considerable distance off the South Atlantic States.

November 19, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,700 m.

There were few to 2/10 Ci.-St. and Ci.- Cu. from the west.

Pressure was low over the Gulf of St. Lawrence and high over the Gulf of Mexico.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Nov. 20, 1911:	*mm.*	*C.*	*%*		*m. p. s.*	*m.*	*mm.*	*C.*	*%*		*m. p. s.*
9.03 a. m....	712.5	0.8	72	s.	11.2	526	712.5	0.8	72	s.	11.2
9.10 a. m....	712.5	0.9	73	s.	10.3	1,002	671.8	4.1	73	sw.	24.5
9.25 a. m....	712.4	1.4	70	s.	11.2	1,569	626.3	1.0	84	w.	26.5
9.55 a. m....	712.3	2.0	71	s.	8.9	2,116	584.6	−5.1	97	w.	23.5
9.58 a. m....	712.3	2.1	71	s.	8.9	2,166	581.0	−3.7	61	w.	25.5
10.07 a. m....	712.2	2.3	71	s.	8.5	2,429	561.7	−5.2	48	w.	....
10.27 a. m....	712.1	3.4	69	s.	6.7	2,259	573.8	−4.4	34	w.	....
10.29 a. m....	712.1	3.5	69	s.	6.7	2,209	577.4	−5.2	33	w.	....
11.14 a. m....	711.7	5.5	64	s.	6.3	1,608	622.7	−1.9	64	w.	20.6
11.30 a. m....	711.6	6.3	60	s.	7.2	1,012	670.5	4.1	65	wsw.	16.2
11.43 a. m....	711.5	6.6	62	s.	5.4	526	711.5	6.6	62	s.	5.4
Nov. 21, 1911:											
1.09 p. m....	714.9	0.0	62	wnw.	10.3	526	714.9	0.0	62	wnw.	10.3
1.17 p. m....	715.0	0.2	70	wnw.	13.9	877	684.2	− 3.9	......	nw.	17.6
1.28 p. m....	715.0	0.6	58	nw.	11.2	1,327	646.1	− 8.5	......	nw.	17.6
1.47 p. m....	715.0	0.9	58	nw.	14.3	2,137	581.4	−15.0	......	nw.	17.1
3.12 p. m....	715.3	0.1	67	wnw.	16.1	2,613	545.6	−19.4	......	nw.	16.8
3.15 p. m....	715.3	0.1	68	wnw.	15.6	2,583	547.7	−17.5	......	nw.	20.5
3.33 p. m....	715.4	−0.2	72	wnw.	14.3	2,105	583.6	−15.8	......	nw.	20.5
4.02 p. m....	715.6	−0.4	72	nw.	15.2	1,418	638.9	−10.2	......	nw.	20.5
4.16 p. m....	715.7	−0.6	74	wnw.	14.3	928	680.4	− 4.9	......	nw.	22.4
4.25 p. m....	715.8	−0.6	74	wnw.	12.1	526	715.8	− 0.6	74	wnw.	12.1
Nov. 22, 1911:											
9.18 a. m....	721.8	−2.3	79	wnw.	10.7	526	721.8	−2.3	79	wnw.	10.7
9.26 a. m....	721.8	−2.1	79	wnw.	10.3	823	695.2	−5.1	82	nw.	16.2
9.33 a. m....	721.8	−1.9	79	wnw.	12.1	1,070	673.5	−7.3	83	nw.	18.1
10.06 a. m....	721.9	−1.3	80	wnw.	10.7	1,118	669.6	−3.5	50	nnw.	8.0
10.31 a. m....	722.1	−0.7	75	wnw	9.4	1,211	662.1	−4.8	49	nnw.	7.8
10.47 a. m....	722.2	−0.6	78	wnw.	9.8	1,823	612.4	−7.4	45	nnw.	9.2
10.52 a. m....	722.3	−0.5	79	wnw.	10.3	1,395	647.0	−7.0	45	nnw.	8.2
11.06 a. m....	722.2	−0.3	81	wnw.	10.3	1,303	654.5	−8.5	63	nw.	7.9
11.22 a. m....	722.1	−0.4	72	wnw.	9.4	915	687.5	−1.1	48	nw.	5.7
11.28 a. m....	722.0	−0.3	70	wnw.	9.8	827	695.2	−4.3	46	nw.	9.1
11.39 a. m....	721.9	0.0	71	wnw.	8.9	526	721.9	0.0	71	wnw.	8.9

November 20, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4,000 m., at maximum altitude.

There were 9/10 to a few St.-Cu. and after 10.09 a. m. 1/10 to a few Ci., all from the west.

Pressure was low over Michigan and high over the Gulf States.

November 21, 1911.—Five kites were used; lifting surface, 30.6 sq. m. Wire out, 6,000 m.; at maximum altitude, 4,000 m.

There were 8/10 to 1/10 St.-Cu. from the northwest. The head kite entered St.-Cu. at 1.38 p. m., altitude about 1,650 m., and was hidden by clouds at intervals until 2.52 p. m.

High pressure overlay the eastern half of the country with center over the middle Mississippi Valley. Low pressure was central off the southern New England coast.

November 22, 1911.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 3,800 m.; at maximum altitude, 3,500 m.

There were 3/10 to 5/10 Ci. from the west-northwest, a few Cu. from the northwest and light haze.

Pressure was high over West Virginia and low off Nova Scotia.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.
Nov. 23, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.05 a. m....	719.5	−1.0	72	sse.	8.0	526	719.5	− 1.0	72	sse.	8.0
8.12 a. m....	719.5	−0.6	70	sse.	8.5	929	684.5	4.2	57	ssw.	14.7
8.19 a. m....	719.4	−0.4	72	sse.	8.0	1,319	652.6	7.7	47	sw.	11.8
8.40 a. m....	719.4	−0.6	73	sse.	9.4	2,088	594.3	5.3	46	sw.	10.8
9.10 a. m....	719.3	0.0	72	sse.	8.5	2,513	564.1	2.5	45	sw.	18.5
9.20 a. m....	719.3	0.1	75	sse.	7.2	3,038	528.5	− 0.8	44	sw.	18.5
9.35 a. m....	719.3	0.5	75	s.	8.5	3,745	483.3	− 7.2	51	sw.	21.8
9.48 a. m....	719.3	0.8	76	s.	8.9	4,310	449.1	−11.8	74	sw.	21.8
10.07 a. m....	719.2	1.4	71	s.	9.4	4,683	427.8	−13.0	92	sw.	21.6
10.40 a. m....	718.6	2.2	68	s.	8.9	5,332	392.3	−16.1	83	sw.	23.9
11.15 a. m....	718.0	3.2	65	s.	9.8	4,821	419.1	−15.1	97	sw.	25.6
11.30 a. m....	717.8	3.7	64	s.	10.3	4,332	446.8	−12.6	97	sw.	23.6
11.58 a. m....	717.3	4.6	64	s.	11.2	3,683	485.5	− 6.7	82	sw.	20.6
12.15 p. m...	717.3	4.9	64	s.	12.1	3,030	527.3	− 0.8	65	sw.	19.6
12.37 p. m...	717.2	5.2	63	s.	12.5	2,384	571.3	3.5	50	sw.	16.2
1.02 p. m...	717.2	4.7	68	s.	10.7	1,325	650.1	7.3	49	ssw.	10.8
1.13 p. m...	717.2	4.8	66	s.	10.7	905	684.5	1.6	45	ssw.	14.7
1.21 p. m...	717.2	5.0	59	s.	10.7	526	717.2	5.0	59	s.	10.7
Nov. 24, 1911:											
4.00 p. m....	707.0	−0.8	88	nw.	21.5	526	707.0	− 0.8	88	nw.	21.5
4.08 p. m....	707.1	−0.8	85	nw.	21.4	940	671.1	− 4.9	91	nw.	29.9
4.18 p. m....	707.2	−0.7	82	nw.	21.4	1,472	626.9	− 9.3	95	nw.	34.3
4.30 p. m....	707.4	−0.6	80	nw.	21.4	1,780	602.3	−10.2	75	nw.	32.3
4.48 p. m....	707.6	−0.8	79	nw.	22.7	1,476	626.9	− 9.9	84	nw.	....
5.15 p. m....	707.7	−1.0	80	nw.	24.1	946	671.1	− 5.4	92	nw.	30.4
5.29 p. m....	707.7	−0.9	81	nw.	....	526	707.7	− 0.9	81	nw.	....
Nov. 25, 1911:											
9.54 a. m....	714.4	−4.1	68	nw.	9.8	526	714.4	− 4.1	68	nw.	9.8
10.06 a. m....	714.4	−3.9	68	nw.	8.0	790	690.8	− 6.7	74	nw.	16.2
10.25 a. m....	714.5	−3.4	68	nw.	7.2	1,247	651.4	−10.9	89	wnw.	17.2
10.38 a. m....	714.5	−3.2	68	nw.	7.6	1,759	609.2	−13.5	93	wnw.	25.5
10.39 a. m....	714.5	−3.2	68	nw.	7.6	1,837	603.0	−10.6	94	wnw.	27.9
10.47 a. m....	714.6	−3.2	68	wnw.	8.5	1,915	597.0	−11.6	96	wnw.	30.4
10.54 a. m....	714.6	−3.2	68	wnw.	8.5	1,948	594.5	− 9.8	94	wnw.	31.5
11.01 a. m....	714.6	−3.1	68	wnw.	8.0	2,203	575.2	− 9.7	87	wnw.	30.0
11.18 a. m....	714.5	−2.9	67	wnw.	8.5	2,562	549.0	− 9.8	73	wnw.	33.2
11.36 a. m....	714.5	−2.7	66	wnw.	8.5	2,659	541.8	−10.8	74	wnw.	33.7
11.45 a. m....	714.4	−2.6	65	wnw.	7.2	2,393	560.8	−12.3	91	wnw.	33.7
11.58 a. m....	714.4	−2.4	64	wnw.	6.7	2,295	568.0	−10.6	96	wnw.	31.7
12.11 p. m....	714.3	−2.3	63	wnw.	5.8	2,023	588.5	−13.7	100	wnw.	25.9
12.24 p. m....	714.1	−2.2	62	wnw.	5.8	1,530	627.7	−13.0	100	wnw.	....
12.32 p. m....	714.0	−2.2	60	wnw.	6.7	526	714.0	− 2.2	60	wnw.	6.7

November 23, 1911.—Seven kites were used; lifting surface, 44.1 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,800 m.

There were a few to 8/10 Ci.-St. and Ci. Cu. from the west. About 1/10 A.-Cu. from the southwest were observed at 12.11 p. m. There was a solar halo.

Pressure was low over Lake Superior and high off the middle Atlantic coast.

November 24, 1911.—Two kites were used; lifting surface, 10.8 sq. m. Wire out, 3,000 m. at maximum altitude.

There were 3/10 to 6/10 St., altitude about 1,300 m., from the northwest and 7/10 to 4/10 A.-St. from the west.

Low pressure was central over the lower St. Lawrence Valley, with a secondary depression over Chesapeake Bay. Pressure was high over Texas.

November 25, 1911.—Four kites were used; lifting surface, 24.3 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,200 m.

St.-Cu., from the west-northwest, altitude about 1,400 m., decreased from 9/10 to 5/10. Light snow fell from 9.50 to 10 and from 10.50 to 10.52 a. m.

A deep depression was central off Nova Scotia; pressure was high over the Gulf States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.	Height.	Pressure.	Temperature.	Rel. Hum.	Wind. Direction.	Wind. Velocity.
Nov. 26, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.54 a. m....	713.2	2.0	44	sw.	5.8	526	713.2	2.0	44	sw.	5.8
9.01 a. m....	713.2	2.6	43	sw.	6.3	910	680.0	0.9	43	wsw.	13.7
9.17 a. m....	713.2	3.1	41	ssw.	6.3	1,627	621.7	−2.4	43	w.	21.6
9.25 a. m....	713.2	3.6	40	ssw.	6.7	1,853	604.4	−0.4	40	w.	24.6
9.28 a. m....	713.2	3.8	40	ssw.	6.7	1,950	597.1	−0.8	44	w.	26.6
9.38 a. m....	713.2	4.1	39	ssw.	6.7	1,673	618.1	0.0	38	w.	....
9.40 a. m....	713.2	4.2	39	ssw.	6.7	1,642	620.5	−3.4	40	w.	....
10.08 a. m....	713.2	5.1	37	ssw.	7.6	941	677.5	0.4	44	wsw.	12.8
10.19 a. m....	713.1	5.4	32	ssw.	7.6	526	713.1	5.4	32	ssw.	7.6
Nov. 27, 1911:											
10.41 a. m....	722.7	6.2	52	se.	5.8	526	722.7	6.2	52	se.	5.8
11.13 a. m....	722.6	6.9	52	se.	5.8	1,046	678.3	5.7	50	s.	7.4
11.56 a. m....	722.5	7.2	51	se.	6.3	1,481	642.9	3.2	49	ssw.	7.4
12.24 p. m....	722.2	6.8	51	se.	6.3	1,829	615.6	0.7	47	ssw.	11.5
12.30 p. m....	722.2	6.8	50	se.	6.3	2,188	588.8	0.7	46	ssw.	7.8
2.48 p. m....	721.4	7.7	50	se.	7.6	3,204	517.5	− 5.2	41	wsw.	12.7
3.15 p. m....	721.2	7.6	54	se.	7.2	4,309	448.9	−13.0	35	wsw.	19.5
3.34 p. m....	721.0	7.4	56	se.	7.6	3,516	497.7	− 8.6	36	wsw.	17.2
3.52 p. m....	720.7	7.0	58	se.	7.6	2,669	553.9	− 1.1	35	sw.	15.8
4.03 p. m....	720.6	6.7	59	se.	8.0	1,898	609.5	3.5	36	sw.	6.8
4.14 p. m....	720.6	6.5	60	se.	8.0	1,560	635.4	4.1	36	ssw.	10.1
4.26 p. m....	720.6	6.3	61	se.	8.0	1,212	663.0	6.7	38	ssw.	10.1
4.34 p. m....	720.6	6.3	63	se.	8.5	870	691.1	6.4	40	s.	12.7
4.39 p. m....	720.6	6.2	63	se.	5.8	526	720.6	6.2	63	se.	5.8
Nov. 28, 1911:											
8.22 a. m.....	713.3	2.4	96	se.	8.9	526	713.3	2.4	96	se.	8.9
8.28 a. m.....	713.3	2.4	96	se.	8.5	1,011	672.1	6.7	96	sse.	24.5
8.37 a. m.....	713.2	2.4	96	se.	8.9	1,280	650.5	7.8	88	s.	29.4
8.47 a. m.....	713.1	2.5	96	se.	8.9	1,815	609.5	4.0	80	s.	33.8
9.20 a. m.....	712.6	2.6	96	se.	8.9	1,133	661.9	8.0	88	sse.	29.1
9.38 a. m.....	712.4	2.5	98	se.	9.8	787	690.0	8.5	90	sse.	24.5
9.42 a. m.....	712.3	2.4	98	se.	10.7	526	712.3	2.4	98	se.	10.7

November 26, 1911.—Three kites were used; lifting surface, 20.9 sq. m. Wire out, 2,500 m. at maximum altitude.

There were 3/10 A.-Cu. from the west.

Pressure was low over Ontario and high over the Gulf States.

November 27, 1911.—Seven kites were used; lifting surface, 44.6 sq. m. Wire out, 6,300 m.; at maximum altitude, 5,400 m.

There were 6/10 to 9/10 Ci.-St. before noon; thereafter 10/10 Ci.-St., Ci.-Cu., and A.-St. until 3 p. m.; then 10/10 Ci.-Cu. All clouds were from the west.

High pressure was central off the Virginia coast and low pressure over northern Texas and eastern Wisconsin.

November 28, 1911.—Two kites were used; lifting surface, 12.6 sq. m. Wire out, 2,600 m. at maximum altitude.

The sky was covered with St.-Cu. from the southwest and St. from the south; altitude of St., 1,400 m. Rain fell after 9.27 a. m.

Pressure was low over Michigan and high off the Atlantic coast.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Nov. 29, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
9.48 a. m....	711.9	− 1.5	72	wnw.	11.2	526	711.9	− 1.5	72	wnw.	11.2
10.04 a. m....	712.1	− 1.7	76	wnw.	11.2	981	672.2	− 6.1	87	wnw.	13.9
10.21 a. m....	712.2	− 1.8	77	wnw.	14.8	1,588	621.8	−11.1	96	wnw.	20.3
10.25 a. m....	712.2	− 1.8	76	wnw.	14.8	1,758	608.2	−10.3	85	wnw.	24.2
10.25 a. m....	712.2	− 1.8	75	wnw.	14.8	1,962	592.4	− 7.6	70	wnw.	22.8
10.32 a. m....	712.3	− 1.8	73	wnw.	17.0	2,339	564.6	− 6.5	33	w.	30.9
10.43 a. m....	712.3	− 2.1	77	wnw.	12.1	2,911	524.3	− 8.6	25	wsw.	41.0
11.25 a. m....	712.4	− 2.4	84	wnw.	12.1	2,334	564.6	− 6.9	13	w.	31.0
11.30 a. m....	712.4	− 2.3	85	wnw.	12.1	1,941	593.6	− 7.3	13	w.	17.2
11.35 a. m....	712.4	− 2.3	82	wnw.	11.6	1,943	593.6	− 6.2	13	wnw.	15.8
11.44 a. m....	712.4	− 2.3	76	wnw.	13.4	1,552	624.4	−12.0	27	wnw.	15.8
11.58 a. m....	712.4	− 2.4	75	wnw.	10.7	791	688.8	− 6.7	83	wnw.	14.7
12.09 p. m....	712.4	− 2.6	78	wnw.	13.4	526	712.4	− 2.6	78	wnw.	13.4
Nov. 30, 1911:											
8.08 a. m....	715.8	− 5.8	77	wnw.	13.0	526	715.8	− 5.8	77	wnw.	13.0
8.15 a. m....	715.8	− 5.8	77	wnw.	13.0	959	677.2	− 7.8	75	wnw.	19.6
8.21 a. m....	715.8	− 5.6	77	wnw.	12.5	1,003	673.4	− 7.7	74	wnw.	21.5
8.27 a. m....	715.8	− 5.6	77	wnw.	13.0	1,228	654.3	− 4.3	54	nnw.	12.2
8.48 a. m....	715.9	− 5.2	78	wnw.	12.5	1,553	628.1	− 5.4	41	nnw.	8.3
9.29 a. m....	715.9	− 4.2	73	wnw.	12.1	2,088	586.4	−10.4	38	nnw.	8.8
10.07 a. m....	716.0	− 3.5	68	wnw.	13.9	3,777	469.1	−20.0	38	nnw.	20.1
10.25 a. m....	716.0	− 2.9	65	wnw.	13.9	3,437	490.8	−19.6	38	nw.	20.3
10.40 a. m....	715.9	− 2.6	63	wnw.	14.8	2,563	551.5	−14.7	38	nw.	9.8
10.53 a. m....	715.9	− 2.6	62	wnw.	13.4	1,919	599.7	− 7.6	36	nw.	10.8
11.10 a. m....	715.8	− 2.4	59	wnw.	13.4	1,466	635.5	− 4.4	35	nw.	16.7
11.17 a. m....	715.7	− 2.4	58	wnw.	13.0	1,082	667.0	− 3.2	35	wnw.	22.8
11.26 a. m....	715.6	− 2.4	57	wnw.	13.4	858	686.2	− 6.4	31	wnw.	15.9
11.37 a. m....	715.5	− 1.8	55	wnw.	15.6	526	715.5	− 1.8	55	wnw.	15.6

November 29, 1911.—Three kites were used; lifting surface, 17.1 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,900 m.

The sky was covered with Ci.-St. and A.-St. from the west-southwest. These were partially obscured by 3/10 to 8/10 St.-Cu. from the west-southwest; altitude, 1,300 m.

A ridge of high pressure extended from Idaho to Texas and low pressure was central over New Brunswick.

November 30, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 7,000 m.; at maximum altitude, 5,950 m.

There were 2/10 A.-Cu. of an indeterminate direction at the beginning of the flight. They increased to 9/10 by 11.11 a. m., and were from the northwest, but by 11.37 a. m. they had decreased to 7/10.

High pressure was central over the western Gulf coast. Pressure was low over Ontario.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 1, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.53 a. m....	717.4	− 0.4	48	wnw.	6.7	526	717.4	− 0.4	48	wnw.	6.7
9.02 a. m....	717.4	0.0	48	w.	7.2	899	684.5	− 3.8	47	w.	12.2
9.12 a. m....	717.4	0.0	47	w.	8.0	1,497	635.0	0.1	42	wnw.	18.2
9.32 a. m....	717.3	1.0	46	w.	10.3	2,396	567.8	0.3	19	wnw.	11.8
10.00 a. m....	717.3	0.9	44	w.	6.7	3,144	516.8	− 5.1	16	w.	14.7
10.12 a. m....	717.2	1.3	43	w.	5.8	3,755	477.6	−11.5	16	w.	17.5
11.11 a. m....	716.4	2.6	38	w.	4.9	4,310	443.7	−16.7	20	wsw.	22.8
11.51 a. m....	715.9	4.8	34	sw.	3.5	4,596	426.9	−19.3	27	wsw.	25.0
11.58 a. m....	715.8	5.0	33	sw.	2.2	4,704	420.4	−18.9	31	wsw.	24.2
12.23 p. m....	715.6	6.0	32	ssw.	4.0	4,565	428.0	−18.9	32	wsw.	25.5
12.47 p. m....	715.5	6.1	31	se.	6.3	3,753	476.5	−12.6	32	wsw.	23.5
1.02 p. m....	715.4	6.6	31	s.	6.7	2,947	528.6	− 5.8	26	wsw.	19.6
1.20 p. m....	715.3	6.4	30	se.	5.8	2,651	548.7	− 3.3	24	wsw.	19.6
1.32 p. m....	715.2	6.4	30	se.	6.7	1,980	596.8	0.6	22	w.	17.0
1.48 p. m....	715.1	6.1	29	se.	7.2	1,386	642.6	− 1.4	20	wsw.	9.1
2.00 p. m....	715.0	5.8	29	s.	5.8	850	687.0	0.4	23	s.	11.2
2.08 p. m....	715.0	5.7	29	s.	7.6	526	715.0	5.7	29	s.	7.6
Dec. 2, 1911:											
8.26 a. m....	712.9	0.8	79	wnw.	5.8	526	712.9	0.8	79	wnw.	5.8
8.35 a. m....	713.0	1.4	76	w.	6.3	970	674.5	− 2.6	85	w.	17.6
8.44 a. m....	713.1	1.6	75	w.	6.3	1,674	616.7	− 8.8	96	wnw.	22.0
8.48 a. m....	713.1	1.9	74	w.	6.3	1,720	613.0	− 7.7	87	wnw.	24.0
8.51 a. m....	713.2	2.0	73	w.	7.2	1,736	611.8	− 9.3	86	wnw.	25.0
8.53 a. m....	713.2	2.1	72	w.	7.2	1,844	603.2	− 8.4	88	wnw.	25.0
9.06 a. m....	713.2	2.5	68	w.	7.6	2,486	555.0	−13.2	78	wnw.	25.0
9.20 a. m....	713.2	2.4	70	w.	6.7	2,971	520.8	−17.7	76	wnw.	24.0
9.37 a. m....	713.2	3.2	67	w.	10.7	3,570	480.4	−23.5	83	wnw.	26.2
9.42 a. m....	713.2	3.5	65	w.	12.5	3,726	470.2	−22.8	72	wnw.	25.9
9.58 a. m....	713.2	3.8	56	w.	14.8	4,457	425.4	−24.1	45	w.	29.4
10.22 a. m....	713.3	4.4	56	wnw.	15.6	5,169	385.8	−27.0	31	w.	32.4
11.01 a. m....	713.4	4.1	57	wnw.	12.5	4,398	428.6	−24.8	24	w.	26.5
11.33 a. m....	713.4	4.6	58	wnw.	10.7	3,630	476.0	−20.3	24	wnw.	22.8
12.03 p. m....	713.4	4.2	53	wnw.	14.3	2,347	564.6	−13.8	36	wnw.	19.6
12.21 p. m....	713.4	4.2	60	wnw.	9.8	1,200	655.4	− 8.6	83	wnw.	18.7
12.27 p. m....	713.4	4.0	60	wnw.	11.6	976	674.5	− 2.6	77	wnw.	21.1
12.41 p. m....	713.4	4.7	54	wnw.	13.4	526	713.4	4.7	54	wnw.	13.4

December 1, 1911.—Seven kites were used; lifting surface, 44.6 sq. m. Wire out, 9,000 m.; at maximum altitude, 8,100 m.

There were 8/10 to a few A.-Cu. and Ci.-Cu. from the west until 11.47 a. m. and 1/10 Ci.-St. from the west-southwest after 1.37 p. m.

Pressure was high over the Louisiana coast and low over the Gulf of St. Lawrence.

December 2, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 8,500 m.; at maximum altitude, 8,400 m.

A.-Cu. from the west-northwest, decreased from 3/10 to none by 9 a. m. St.-Cu. from the west-northwest, altitude, 1,500 m., increased from 3/10 to 8/10 by 11 a. m.

Pressure was low over northern New York and high over the Gulf of Mexico.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 3, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
10.50 a. m....	713.8	0.6	65	se.	5.8	526	713.8	0.6	65	se.	5.8
11.10 a. m....	713.5	0.1	76	sse.	9.4	1,067	666.6	− 4.3	77	s.	12.2
11.26 a. m....	713.3	0.6	70	sse.	10.7	1,340	643.8	− 1.7	82	ssw.	9.8
11.33 a. m....	713.2	0.9	69	se.	11.6	2,034	589.7	− 4.5	91	sw.	20.5
11.48 a. m....	712.9	1.1	66	se.	12.5	2,849	531.2	− 9.4	97	sw.	25.5
12.07 p. m....	712.6	1.0	68	se.	11.2	3,398	494.0	−13.7	97	sw	29.1
12.39 p. m....	712.3	0.9	70	se.	9.8	2,801	533.6	−10.3	99	sw.	23.5
12.51 p. m....	712.1	0.9	71	se.	12.1	2,464	557.2	− 8.2	99	sw.	26.9
12.57 p. m....	712.0	0.8	71	se.	10.3	2,297	569.2	− 8.2	100	ssw.	24.5
1.06 p. m....	712.0	0.8	72	se.	11.2	2,021	589.7	− 6.2	99	ssw.	25.5
1.10 p. m....	711.9	1.0	72	se.	12.5	1,958	594.5	− 6.5	89	ssw.	24.0
1.26 p. m....	711.8	0.9	69	se.	9.8	1,405	637.6	− 2.2	52	ssw.	17.6
1.31 p. m....	711.8	1.0	69	se.	9.8	990	671.6	− 0.7	50	s.	13.7
1.37 p. m....	711.8	1.0	68	se.	10.7	900	679.3	− 2.5	60	sse.	15.2
1.42 p. m....	711.7	1.0	68	se.	10.7	526	711.7	1.0	68	se.	10.7
Dec. 4, 1911:											
10.18 a. m....	719.2	−5.6	85	wnw.	18.8	526	719.2	− 5.6	85	wnw.	18.8
10.25 a. m....	719.2	−5.4	82	wnw.	19.7	840	690.8	− 9.2	90	nw.	24.5
10.32 a. m....	719.2	−5.2	80	wnw.	19.7	1,205	659.0	− 7.7	55	nw.	....
10.43 a. m....	719.2	−5.2	71	wnw.	19.7	1,506	634.1	− 6.0	44	nnw	19.6
10.56 a. m....	719.3	−5.6	70	wnw.	20.6	1,523	632.8	− 6.6	49	nnw.	16.9
11.03 a. m....	719.3	−5.0	66	wnw.	20.6	1,974	597.3	− 8.1	44	nnw.	16.7
11.05 a. m....	719.3	−5.0	66	wnw.	20.6	1,846	607.0	− 9.3	44	nnw.	16.8
11.33 a. m....	719.5	−5.0	62	wnw.	17.9	2,420	563.6	−10.9	43	nnw.	16.3
11.52 a. m....	719.6	−5.2	62	wnw.	19.7	1,815	609.4	− 8.6	40	nnw.	20.9
12.03 p. m....	719.6	−5.0	64	wnw.	18.8	1,582	627.9	− 7.5	37	nnw.	19.2
12.10 p. m....	719.6	−4.9	65	wnw.	17.9	1,568	629.1	−10.7	37	nw.	....
12.22 p. m....	719.6	−4.6	65	wnw.	20.6	1,386	644.0	−10.8	53	nw.	23.5
12.25 p. m....	719.6	−4.2	64	wnw.	18.8	1,357	646.5	− 9.5	55	nw.	27.4
12.30 p. m....	719.6	−4.2	64	wnw.	17.9	1,282	652.8	− 9.7	56	nw.	28.4
12.33 p. m....	719.6	−4.2	64	wnw.	19.7	1,240	656.5	−11.7	61	nw.	27.5
12.45 p. m....	719.6	−3.5	65	wnw.	17.4	920	684.4	− 8.7	72	nw.	20.6
12.53 p. m....	719.6	−4.2	74	nw.	21.5	526	719.6	− 4.2	74	nw.	21.5

December 3, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,800 m.

The sky was overcast with St. from the southwest; altitude, 2,000 m. Light snow fell from 10.50 to 11.25 a. m.

Pressure was low over Indiana and Ohio and high off the southeastern States.

December 4, 1911.—Four kites were used; lifting surface, 21.6 sq. m. Wire out, 4,500 m.; at maximum altitude, 3,550 m.

There were a few St.-Cu. from the west-northwest.

High pressure, central over the middle Mississippi Valley, covered the United States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 5, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.23 a. m....	724.2	−4.7	......	wnw.	9.4	526	724.2	− 4.7	......	wnw.	9.4
8.30 a. m....	724.2	−4.8	64	wnw.	10.3	895	690.9	− 6.6	67	nw.	16.7
8.46 a. m....	724.4	−4.8	66	wnw.	9.8	1,301	656.7	3.1	48	nnw.	14.9
8.58 a. m....	724.5	−4.4	71	nw.	9.8	1,933	607.3	0.0	63	nnw.	13.2
9.28 a. m....	724.7	−3.6	64	wnw.	9.4	2,181	589.1	− 0.1	62	nnw.	17.0
9.50 a. m....	724.9	−3.3	64	wnw.	8.7	2,688	552.7	− 4.8	80	nw.	11.3
10.19 a. m...	724.9	−2.9	59	wnw.	7.6	3,358	507.7	− 6.6	67	nw.	22.3
10.32 a. m...	724.9	−2.4	65	wnw.	8.9	3,571	494.1	− 7.5	65	nw.	20.6
11.03 a. m....	724.8	−1.6	62	wnw.	6.7	4,179	456.6	−12.4	58	wnw.	25.0
11.46 a. m....	724.6	−0.3	54	wnw.	6.7	4,882	416.0	−17.7	53	nw.	30.6
12.16 p. m....	724.5	0.3	59	w.	5.4	4,328	447.7	−13.6	45	nw.	25.2
12.40 p. m....	724.3	1.1	48	w.	4.7	3,284	512.4	− 7.6	75	nw.	18.8
12.57 p. m....	724.1	1.3	46	wnw.	7.2	2,431	571.1	− 2.0	61	nw.	17.2
1.15 p. m....	724.0	1.3	53	wnw.	6.7	2,002	602.4	− 1.2	71	nw.	14.8
1.29 p. m....	724.0	2.1	58	w.	4.5	1,419	647.9	1.4	54	nw.	12.6
1.36 p. m....	723.9	2.3	51	w.	4.8	1,110	673.1	2.4	51	wnw.	13.0
1.38 p. m....	723.9	2.3	48	w.	4.9	990	683.3	− 0.5	41	wnw.	7.8
1.45 p. m....	723.9	2.2	36	w.	5.1	526	723.9	2.2	36	w.	5.1
Dec. 6, 1911:											
8.09 a. m....	723.6	2.3	68	w.	10.7	526	723.6	2.3	68	w.	10.7
8.16 a. m....	723.6	2.6	66	w.	10.3	968	685.5	7.4	47	wnw.	18.2
8.26 a. m....	723.7	2.6	66	w.	10.3	1,315	657.5	8.9	44	nw.	10.3
9.01 a. m....	723.9	4.1	62	w.	11.2	1,899	612.8	5.9	50	hw.	8.9
9.45 a. m....	724.5	5.4	57	w.	8.0	2,303	583.7	2.6	53	wnw.	9.6
10.30 a. m....	724.3	5.7	56	w.	8.9	2,708	555.0	1.8	50	w.	10.1
10.37 a. m....	724.3	6.0	55	w.	9.4	2,917	540.8	0.8	50	w.	11.4
10.50 a. m....	724.3	6.5	57	w.	7.6	2,352	580.1	2.7	53	w.	9.8
10.59 a. m...	724.3	6.7	57	w.	6.7	1,610	635.1	7.6	54	wnw.	7.9
11.08 a. m....	724.2	7.0	55	w.	7.2	1,433	648.7	9.1	50	wnw.	8.3
11.18 a. m....	724.2	7.0	55	w.	6.7	1,038	680.4	6.5	45	wnw	16.6
11.26 a. m....	724.1	7.6	49	w.	7.2	526	724.1	7.6	49	w.	7.2
Dec. 7, 1911:											
11.41 a. m....	723.9	13.8	42	ssw.	0.9	526	723.9	13.8	42	ssw.	0.9
11.59 a. m....	723.8	13.1	44	sw.	1.8	1,835	618.7	6.9	......	sw.	....
12.06 p. m...	723.8	13.2	44	sw.	0.9	1,596	636.8	8.8	......	wsw.	....
12.20 p. m...	723.7	13.4	43	wsw.	0.9	1,062	679.0	10.7	......	wnw.	....
12.26 p. m...	723.7	13.5	44	wsw.	2.2	526	723.7	13.5	44	wsw.	2.2

December 5, 1911.—Eight kites were used; lifting surface, 50.4 sq. m. Wire out, 9,500 m.; at maximum altitude, 8,350 m.

There were 4/10 to a few Ci.-St. from the north until 1 p. m., from the north-northwest thereafter. 5/10 A.-St. from the north-northwest at the beginning of the flight had disappeared shortly after noon.

High pressure was central over West Virginia and pressure was low north of Lake Superior.

December 6, 1911.—Six kites were used; lifting surface, 37.8 sq. m. Wire out, 5,200 m.; at maximum altitude, 3,400 m.

There were a few Ci. near the horizon before 10 a. m.

A ridge of high pressure extended from West Virginia to Georgia. Pressure was low over Manitoba.

December 7, 1911.—One captive balloon was used, capacity, 22.4 cu. m. Wire out, 1,900 m.

There were a few St. on the southwestern horizon.

High pressure, central over southeastern West Virginia, covered the eastern United States. Pressure was relatively low over western Ontario and southeastern Texas.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 8, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
6.56 a. m.....	724.9	5.8	53	nw.	8.5	526	724.9	5.8	53	nw.	8.5
6.58 a. m.....	724.9	5.9	53	nw.	8.5	629	715.8	7.6	51	nnw.	13.0
7.08 a. m.....	724.9	5.8	52	nw.	8.0	901	692.6	7.0	60	nnw.	12.7
9.22 a. m.....	725.4	9.4	54	nw.	4.0	1,184	669.7	5.6	61	nw.	6.9
9.27 a. m.....	725.4	9.5	53	nw.	3.6	1,574	638.5	4.1	49	nw.	7.0
9.36 a. m.....	725.5	9.6	52	nw.	4.0	1,815	620.0	4.5	39	nw.	8.1
9.45 a. m.....	725.5	9.8	50	nw.	4.5	1,216	667.2	5.4	39	nw.	8.3
9.56 a. m.....	725.5	9.2	55	nw.	3.1	834	699.0	6.0	52	nw.	8.9
9.59 a. m.....	725.5	9.0	58	nw.	3.1	526	725.5	9.0	58	nw.	3.1
Dec. 9, 1911:											
10.48 a. m....	723.5	13.6	56	w.	4.0	526	723.5	13.6	56	w.	4.0
11.03 a. m...	723.4	12.6	59	w.	2.7	1,632	633.5	7.0	......	w.	......
11.12 a. m....	723.3	12.6	59	w.	2.7	1,239	664.2	9.5	......	w.	......
11.32 a. m....	723.2	13.5	52	w.	4.0	526	723.2	13.5	52	w.	4.0
Dec. 10, 1911:											
8.16 a. m....	723.1	10.7	63	s.	8.0	526	723.1	10.7	63	s.	8.0
8.20 a. m....	723.1	10.9	63	sse.	7.6	647	712.7	12.1	58	ssw.	11.1
8.25 a. m....	723.1	10.8	67	sse.	8.0	911	690.6	11.2	57	ssw.	16.2
8.39 a. m....	723.1	10.6	69	sse.	8.9	1,385	652.4	9.4	52	ssw.	13.2
8.56 a. m....	723.1	11.4	67	sse.	10.3	1,891	613.8	5.3	42	ssw.	11.1
9.16 a. m....	723.1	11.3	67	s.	11.2	2,611	561.8	2.0	32	ssw.	14.4
9.40 a. m....	723.2	11.6	63	sse.	4.9	3,210	521.6	− 0.3	20	sw.	14.9
9.51 a. m....	723.2	11.9	63	sse.	5.8	3,499	503.1	− 3.3	20	sw.	15.2
10.01 a. m....	723.2	12.1	61	s.	5.8	4,128	464.3	− 8.0	20	sw.	16.4
10.30 a. m....	722.9	12.8	55	sse.	5.8	4,731	429.4	−10.7	29	sw.	15.9
11.19 a. m....	722.4	12.6	62	sse.	5.8	4,994	414.2	−11.2	38	sw.	20.4
11.49 a. m....	722.1	12.5	62	s.	6.7	4,086	465.4	− 7.2	33	sw.	11.0
12.06 p. m...	722.0	12.6	59	s.	6.7	3,655	491.6	− 6.1	33	sw.	18.4
12.26 p. m...	722.0	12.5	63	ese.	4.9	2,886	541.6	0.1	30	sw.	14.3
12.42 p. m...	721.9	12.7	65	ese.	6.3	2,185	590.7	2.4	26	sw.	16.2
12.54 p. m...	721.9	13.2	63	ese.	7.2	1,530	639.9	8.3	33	ssw.	18.2
1.13 p. m...	721.9	14.2	55	se.	7.6	929	688.1	9.9	52	ssw.	22.5
1.21 p. m...	721.8	14.4	50	se.	7.6	526	721.8	14.4	50	se.	7.6

December 8, 1911.—Five kites were used; lifting surface, 32.0 sq. m. Wire out, 3,400 m.; at maximum altitude, 1,600 m.

The sky was cloudless, but there was light haze.

High pressure, with centers over Virginia and Nevada, covered most of the country. Low pressure was central over Saskatchewan.

December 9, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,900 m.

There were 10/10 Ci.-St. from the west. A solar halo was observed.

Pressure was low over western Texas and high along the middle and north Atlantic coast.

December 10, 1911.—Eight kites were used; lifting surface, 55.3 sq. m. Wire out, 9,500 m.; at maximum altitude, 7,500 m.

There were 2/10 to 7/10 Ci.-Cu. from the west-southwest until 10.00 a. m. and 4/10 to 5/10 Ci.-St. from the west after 11.10 a. m. There were 3/10 to 1/10 A.-Cu. from the southwest after 9.30 a. m. A solar halo was observed.

High pressure was central over the Virginia coast and low pressure over Iowa.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 11, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
7.53 a. m....	722.8	9.6	80	s.	8.5	526	722.8	9.6	80	s.	8.5
7.57 a. m....	722.8	9.6	79	s.	9.4	792	700.1	11.1	85	ssw.	19.6
8.03 a. m....	722.8	9.6	80	s.	9.8	994	683.4	10.8	82	ssw.	22.0
8.16 a. m....	722.9	9.8	77	s.	8.5	1,531	640.8	9.3	82	ssw.	16.2
8.35 a. m....	722.9	10.0	77	s.	8.5	2,219	589.4	3.6	90	sw.	13.2
10.32 a. m....	722.8	11.6	77	s.	7.2	2,523	567.8	2.1	87	sw.	5.9
11.23 a. m....	722.7	12.7	73	sse.	7.6	2,219	589.4	3.7	86	ssw.	11.3
11.40 a. m....	722.7	13.8	71	sse.	9.8	1,566	638.2	8.8	77	ssw.	18.6
11.42 a. m....	722.7	13.9	71	sse.	9.8	1,388	651.9	10.1	76	ssw.	18.2
11.45 a. m....	722.6	14.1	71	sse.	8.9	1,086	675.8	10.5	69	ssw.	22.1
11.54 a. m....	722.6	14.4	71	sse.	8.9	885	692.4	9.7	87	s.	18.9
11.58 a. m....	722.6	14.4	72	sse.	8.9	526	722.6	14.4	72	sse.	8.9
Dec. 12, 1911:											
2.32 p. m.....	718.5	14.5	80	sse.	6.3	526	718.5	14.5	80	sse.	6.3
2.42 p. m.....	718.5	14.6	76	sse.	6.3	907	686.8	12.6	86	ssw.	8.8
2.59 p. m.....	718.4	14.7	76	sse.	4.5	1,415	646.1	7.4	85	ssw.	11.8
3.19 p. m.....	718.4	14.7	76	sse.	4.5	1,545	636.1	8.5	77	ssw.	13.1
3.26 p. m.....	718.4	14.9	75	se.	5.4	1,807	616.3	9.2	44	ssw.	11.8
3.29 p. m.....	718.4	14.9	75	se.	5.4	2,043	599.0	8.5	39	ssw.	12.2
4.00 p. m.....	718.4	14.1	80	sse.	5.4	2,623	558.0	3.7	28	ssw.	15.4
4.24 p. m.....	718.5	13.8	80	sse.	4.5	3,665	490.0	−1.4	13	ssw.	23.9
4.54 p. m.....	718.6	13.6	84	sse.	5.4	2,910	537.8	2.1	12	ssw.	24.5
5.04 p. m.....	718.6	13.5	82	s.	6.3	2,559	561.6	2.1	12	ssw.	18.6
5.08 p. m.....	718.6	13.5	82	s.	6.3	2,353	576.0	4.9	12	ssw.	19.6
5.17 p. m.....	718.6	13.4	81	s.	6.3	2,183	588.1	6.0	12	ssw.	14.5
5.24 p. m.....	718.6	13.4	81	s.	6.3	1,702	623.7	4.6	24	ssw.	12.3
5.30 p. m.....	718.6	13.4	81	s.	6.3	1,523	637.4	6.0	62	ssw.	14.7
5.42 p. m.....	718.7	13.4	81	s.	5.4	922	685.6	9.8	79	ssw.	14.2
5.49 p. m.....	718.7	13.2	81	s.	7.2	526	718.7	13.2	81	s.	7.2
Dec. 13, 1911:											
8.04 a. m....	714.5	11.6	71	w.	8.5	526	714.5	11.6	71	w.	8.5
8.10 a. m....	714.6	11.3	72	w.	7.6	987	676.3	11.3	70	wnw.	19.6
8.31 a. m....	714.8	10.3	74	nw.	12.5	1,495	637.1	6.3	83	w.	21.6
8.39 a. m....	714.9	10.0	74	nw.	18.4	1,962	601.2	7.8	68	w.	24.2
8.54 a. m....	715.0	9.6	75	nw.	13.9	2,474	565.0	5.2	66	w.	21.6
9.21 a. m....	715.2	9.4	76	nw.	14.3	3,499	496.7	−3.9	85	wsw.	26.5
10.10 a. m....	715.6	8.3	74	nw.	17.9	2,409	568.6	4.3	65	w.	22.5
10.20 a. m....	715.6	8.0	72	nw.	17.9	2,289	577.0	3.4	63	w.	24.5
10.42 a. m....	715.8	7.6	69	wnw.	18.8	1,495	635.8	8.2	31	wnw.	24.5
11.02 a. m....	715.9	7.5	69	wnw.	14.3	990	676.3	1.5	88	wnw.	21.6
11.14 a. m....	716.0	7.5	69	nw.	12.5	526	716.0	7.5	69	nw.	12.5

December 11, 1911.—Eight kites were used; lifting surface, 50.4 sq. m. Wire out, 8,500 m.; at maximum altitude, 6,800 m.

There were 4/10 to 7/10 A.-Cu. and Ci.-Cu. from the southwest.

Pressure was low over Lake Superior, with a secondary depression over southern Indiana, and high off Nova Scotia and New England.

December 12, 1911.—Five kites were used; lifting surface, 36.4 sq. m. Wire out, 4,500 m.; at maximum altitude, 4,250 m.

Ci.-St. from the west, Ci.-Cu. from the southwest, and A.-St. direction indeterminable, varied from 8/10 to 2/10 before 5.00 p. m. St.-Cu. appeared at 4.15 p. m.; and after 5.00 p. m. there were 8/10 St.-Cu., altitude, about 1,500 m., from the south-southwest and 2/10 A.-St. A solar halo was observed at 2.50 p. m.

A trough of relatively low pressure extended from the St. Lawrence River to the Gulf of Mexico. Pressure was high over the Middle Atlantic coast.

December 13, 1911.—Four kites were used, lifting surface, 25.2 sq. m. Wire out, 5,000 m., at maximum altitude.

There were 1/10 to 8/10 A.-St. from the west and a few to 8/10 St.-Cu. from the west-southwest.

Low pressure was central over the Maine coast. Pressure was high over the Middle Mississippi Valley.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 14, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
7.58 a. m....	722.6	−0.6	74	e.	5.4	526	722.6	− 0.6	74	e.	5.4
8.50 a. m....	723.0	−0.6	73	e.	5.8	942	686.4	0.4	41	se.	7.7
9.28 a. m....	723.2	−0.9	82	e.	6.0	1,306	656.0	− 1.5	42	sse.	7.9
10.10 a. m....	723.3	−0.8	82	ese.	5.1	1,917	607.8	− 0.6	41	sse.	8.9
10.28 a. m....	723.1	−0.9	82	ese.	8.0	2,109	593.3	1.6	54	s.	10.5
10.41 a. m....	723.0	−0.9	86	ese.	7.6	2,747	547.8	− 0.2	91	wsw.	19.0
10.58 a. m....	722.8	−1.0	90	ese.	7.2	4,327	448.0	−10.6	93	wsw.	....
11.00 a. m....	722.8	−1.0	90	ese.	7.2	526	722.8	− 1.0	90	ese.	7.2
Dec. 15, 1911:											
3.42 p. m....	714.0	3.9	100	ese.	4.5	526	714.0	3.9	100	ese.	4.5
3.50 p. m....	714.1	3.8	100	ese.	4.0	1,562	629.8	7.2	......	sw.	....
4.00 p. m....	714.1	3.7	100	ese.	3.6	1,129	663.6	8.8	......	n.	....
4.07 p. m....	714.1	3.7	100	ese.	4.0	796	690.9	7.0	......	ne.	....
4.10 p. m....	714.2	3.7	100	ese.	4.0	526	714.2	3.7	100	ese.	4.0
Dec. 16, 1911:											
2.30 p. m....	708.8	4.9	100	se.	6.7	526	708.8	4.9	100	se.	6.7
2.33 p. m....	708.7	5.2	100	se.	6.7	885	678.7	12.1	93	wsw.	18.4
2.40 p. m....	708.7	5.6	100	se.	7.6	1,085	662.6	11.8	95	wsw.	18.4
2.48 p. m....	708.7	5.7	100	se.	7.6	1,362	641.0	8.9	100	wsw.	15.2
3.00 p. m....	708.7	5.9	100	se.	7.2	1,676	617.2	9.4	80	wsw.	29.4
3.06 p. m....	708.7	5.9	100	se.	7.2	1,877	602.4	9.4	49	wsw.	31.9
3.17 p. m....	708.7	5.7	100	se.	6.7	1,995	594.3	9.2	56	wsw.	34.0
3.36 p. m....	708.7	5.9	100	se.	5.8	1,357	642.0	12.4	85	w.	31.3
4.05 p. m....	708.7	5.6	100	se.	6.3	1,128	659.6	13.7	84	w.	14.7
4.17 p. m....	708.7	5.4	100	s.	6.3	737	690.9	13.7	91	w.	12.7
4.20 p. m....	708.7	5.4	100	s.	5.8	526	708.7	5.4	100	s.	5.8

December 14, 1911.—Eight kites were used; lifting surface, 51.9 sq. m. Wire out, 6,000 m.; at maximum altitude, 5,600 m.

There were 10/10 A.-Cu. and A.-St. from the southwest at the beginning of the flight. After 9 a. m. these gradually gave place to St.-Cu. from the southwest. Rain fell after 8.54 a. m. Head kite entered St.-Cu. about 10.30 a. m., altitude about 2,000 m.

A center of high pressure overlay the Middle Atlantic States, and pressure was low over the Gulf of Mexico.

December 15, 1911.—One captive balloon was used; capacity, 22.4 cu. m. Wire out, 1,100 m.

There was dense fog.

A trough of low pressure extended from the lower Lakes to the Gulf, and a slight depression was off the Maryland coast.

December 16, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 3,700 m., at maximum altitude.

There was dense fog.

Low pressure was central over Ohio. Pressure was high over Nova Scotia.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 17, 1911:	*mm.*	*C.*	%		*m.p.s.*	*m.*	*mm.*	*C.*	%		*m.p.s.*
2.07 p. m....	718.4	1.6	72	nw.	10.3	526	718.4	1.6	72	nw.	10.3
2.16 p. m....	718.4	1.6	71	nw.	10.8	1,020	675.2	− 4.5	89	nw.	14.8
2.25 p. m....	718.4	1.6	71	nw.	12.5	1,453	639.0	− 7.6	97	nw.	17.0
2.42 p. m....	718.3	1.6	70	nw.	14.8	1,757	614.8	0.6	29	nw.	12.1
3.24 p. m....	718.5	1.5	69	nw.	12.1	2,470	562.2	− 4.2	25	w.	14.5
3.51 p. m....	718.8	1.4	70	nw.	6.7	3,163	515.1	− 5.5	22	w.	22.9
4.08 p. m....	718.9	1.3	72	nw.	8.5	2,516	559.6	− 5.3	26	....	18.3
4.30 p. m....	719.1	1.2	73	nw.	8.9	1,742	616.6	3.2	24	nw.	13.9
4.33 p. m....	719.1	1.2	72	nw.	9.4	1,400	643.8	− 7.7	36	nw.	13.9
4.39 p. m....	719.3	1.1	73	nw.	9.8	1,029	675.2	− 5.2	80	nw.	15.6
4.53 p. m....	719.5	1.0	76	nw.	8.7	526	719.5	1.0	76	nw.	8.7
Dec. 18, 1911:											
8.19 a. m....	721.7	− 0.6	73	nw.	10.7	526	721.7	− 0.6	73	nw.	10.7
8.35 a. m....	721.7	− 0.6	72	nw.	11.2	944	684.6	− 6.0	86	nnw.	19.3
8.50 a. m....	721.8	− 0.6	72	nw.	11.6	1,258	657.6	− 9.4	92	nnw.	20.2
8.56 a. m....	721.8	− 0.6	72	nw.	11.2	1,571	631.3	−11.5	97	nnw.	24.2
8.59 a. m....	721.8	− 0.6	72	nw.	10.3	1,834	610.5	− 3.2	62	nw.	23.3
9.20 a. m....	721.8	− 0.4	70	nw.	12.5	2,206	582.5	− 5.1	62	nw.	21.2
9.40 a. m....	721.8	− 0.2	67	nw.	11.2	2,867	534.9	−10.7	56	nw.	21.2
10.01 a. m....	721.8	− 0.2	63	nw.	10.7	3,340	502.8	−14.0	66	nw.	26.5
10.30 a. m....	721.8	− 0.1	58	nw.	11.6	2,940	529.7	−10.5	59	nw.	21.1
10.50 a. m....	721.8	0.0	60	nw.	13.4	2,382	569.1	− 6.2	56	nw.	24.8
10.58 a. m....	721.8	0.0	59	wnw.	12.5	1,984	598.7	− 4.3	56	nnw.	24.0
11.12 a. m....	721.8	0.1	58	wnw.	13.4	1,714	619.9	−13.1	75	nnw.	22.4
11.20 a. m....	721.8	0.2	57	wnw.	10.3	1,332	651.6	− 9.4	92	nw.	15.2
11.33 a. m....	721.7	0.6	58	wnw.	11.2	910	687.7	− 4.6	76	nnw.	17.6
11.43 a. m....	721.7	0.6	54	wnw.	11.6	526	721.7	0.6	54	wnw.	11.6
Dec. 19, 1911:											
8.19 a. m....	725.8	−3.4	73	wnw.	10.3	526	725.8	− 3.4	73	wnw.	10.3
8.30 a. m....	725.8	−3.4	76	wnw.	11.2	935	689.0	− 6.8	74	nw.	17.0
8.47 a. m....	725.9	−3.2	76	w.	11.6	1,441	645.5	−11.3	73	nnw.	17.0
8.56 a. m....	725.9	−3.0	73	wnw.	11.2	1,821	614.6	− 6.6	38	nnw.	17.0
9.07 a. m....	725.9	−3.0	72	wnw.	11.6	2,124	591.2	− 8.1	25	nnw.	18.4
9.15 a. m....	726.0	−2.8	72	wnw.	11.2	2,473	565.3	− 6.1	19	nnw.	24.5
9.33 a. m....	726.0	−2.2	71	w.	12.1	3,346	505.5	− 8.9	15	wnw.	....
10.10 a. m....	726.2	−1.8	67	wnw.	10.7	2,924	534.1	− 9.0	14	nw.	26.7
10.44 a. m....	726.1	−1.5	68	wnw.	14.3	1,946	605.6	− 7.9	10	nw.	14.2
10.59 a. m....	726.0	−1.2	69	wnw.	12.1	1,330	655.2	− 4.4	10	nw.	11.5
11.06 a. m....	726.0	−1.2	67	wnw.	12.1	1,133	671.9	− 8.5	26	nw.	14.3
11.13 a. m....	726.0	−1.2	65	wnw.	12.1	859	696.0	− 6.1	39	nw.	13.4
11.25 a. m....	726.0	−1.1	63	wnw.	11.6	526	726.0	− 1.1	63	wnw.	11.6

December 17, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,550 m.

The sky was covered with St.-Cu., from the northwest. The head kite entered St.-Cu. at 2.23 and emerged below it at 4.35 p. m.; altitude about 1,300 m.

Low pressure was central off the Rhode Island coast; high pressure over Indiana.

December 18, 1911.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 5,500 m.; at maximum altitude, 5,300 m.

There were 6/10 to 9/10 St. from the northwest; altitude, 1,450 m.

High pressure was central over Indiana; low pressure over New Mexico.

December 19, 1911.—Four kites were used; lifting surface, 25.2 sq. m. Wire out, 5,000 m.; at maximum altitude, 4,800 m.

There were several bars of stationary clouds over the Shenandoah Valley from 8.30 a. m. to 10.50 a. m., and a few St.-Cu., altitude, about 1,400 m., from the north-northwest after 10.40 a. m.

High pressure, central over Michigan, covered the eastern United States.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 20, 1911:	*mm.*	*C.*	%		*m.p.s.*	*m.*	*mm.*	*C.*	%		*m.p.s.*
1.25 p.m.	724.9	−2.3	65	ese.	6.7	526	724.9	−2.3	65	ese.	6.7
1.45 p.m.	724.5	−2.4	66	se.	6.7	689	709.7	−5.4	77	se.	7.7
1.52 p.m.	724.5	−2.4	67	se.	6.3	1,010	681.3	−5.0	79	se.	11.3
1.56 p.m.	724.4	−2.5	64	se.	6.3	1,188	666.0	−2.3	78	se.	10.8
2.12 p.m.	724.4	−2.2	63	se.	6.7	1,572	634.7	1.8	69	se.	9.4
3.10 p.m.	724.3	−1.6	61	se.	5.4	1,781	618.6	1.1	58	sse.	8.1
3.19 p.m.	724.3	−1.6	60	se.	4.9	2,089	595.4	3.3	55	sse.	9.3
3.26 p.m.	724.3	−1.6	62	se.	4.9	2,309	579.7	3.7	52	sse.	10.1
3.37 p.m.	724.3	−1.8	60	se.	4.5	2,076	596.6	3.9	50	sse.	9.3
3.45 p.m.	724.3	−2.0	61	se.	4.5	1,800	617.3	3.0	50	sse.	10.5
3.47 p.m.	724.3	−2.0	63	se.	4.5	1,703	624.7	3.3	50	sse.	10.5
3.57 p.m.	724.3	−2.0	64	e.	4.5	1,219	663.5	−1.1	48	sse.	11.5
3.59 p.m.	724.3	−2.0	64	ese.	4.5	1,008	681.3	−4.8	48	sse.	13.5
4.01 p.m.	724.3	−2.0	65	ese.	4.5	862	694.1	−5.3	49	sse.	9.3
4.10 p.m.	724.3	−2.1	67	ese.	3.6	526	724.3	−2.1	67	ese.	3.6
Dec. 21, 1911:											
8.13 a.m.	721.5	−4.0	98	se.	6.3	526	721.5	−4.0	98	se.	6.3
8.35 a.m.	721.5	−4.0	94	se.	5.4	937	685.3	2.1	96	s.	12.5
8.55 a.m.	721.5	−3.9	96	se.	4.5	1,447	643.7	5.9	95	ssw.	10.2
9.30 a.m.	721.5	−3.4	91	se.	4.5	2,215	586.1	4.6	97	ssw.	9.8
9.35 a.m.	721.5	−3.5	93	se.	4.5	2,468	568.1	3.1	98	ssw.	12.3
9.47 a.m.	721.5	−3.4	91	se.	2.7	2,196	587.3	4.5	98	ssw.	14.2
9.56 a.m.	721.5	−3.4	91	se.	3.6	1,653	627.6	5.5	100	ssw.	14.7
10.05 a.m.	721.5	−3.5	94	se.	3.6	1,336	652.4	5.3	100	s.	14.2
10.16 a.m.	721.6	−3.4	91	se.	3.1	526	721.6	−3.4	91	se.	3.1
Dec. 23, 1911:											
8.34 a.m.	708.1	6.5	74	wnw.	7.6	526	708.1	6.5	74	wnw.	7.6
8.43 a.m.	708.1	6.5	72	wnw.	9.4	825	682.7	5.1	70	w.	21.6
9.04 a.m.	708.2	6.3	70	wnw.	5.8	1,276	645.8	0.2	78	w.	15.8
9.06 a.m.	708.2	6.4	70	wnw.	5.8	1,689	613.4	1.4	63	w.	31.4
9.15 a.m.	708.2	6.4	69	wnw.	6.3	2,048	586.6	−0.7	47	w.	....
10.24 a.m.	708.3	6.8	67	wnw.	5.8	2,556	550.5	−1.9	43	w.	41.2
10.53 a.m.	708.2	7.1	66	wnw.	5.8	2,135	....	1.6	32	w.	....
11.17 a.m.	708.1	7.4	63	wnw.	4.9	1,651	616.0	0.4	37	w.	34.3
11.22 a.m.	708.0	7.4	65	wnw.	4.9	1,523	625.9	−1.8	55	w.	26.7
11.30 a.m.	708.0	7.5	64	wnw.	6.3	1,257	647.1	−0.4	68	w.	24.5
11.37 a.m.	708.0	7.6	65	wnw.	6.3	885	677.5	3.6	68	w.	20.6
11.46 a.m.	707.9	7.6	65	wnw.	4.9	526	707.9	7.6	65	wnw.	4.9

December 20, 1911.—Six kites were used; lifting surface, 39.8 sq. m. Wire out, 3,500 m.; at maximum altitude, 2,600 m.

There were 6/10 to 9/10 Ci.-St., with solar halo, from the west and few to 2/10 Ci.-Cu., A.-Cu., and A.-St., from the west-southwest.

Pressure was high over New York and low over Oklahoma.

December 21, 1911.—Five kites were used; lifting surface, 31.5 sq. m. Wire out, 3,500 m.; at maximum altitude, 3,200 m.

The sky was covered with St. from the south, altitude, 1,100 m. Light rain fell after 8.58 a. m.

Pressure was high over Vermont and low over Iowa.

December 23, 1911.—Three kites were used; lifting surface, 16.2 sq. m. Wire out, 4,000 m., at maximum altitude.

The sky was overcast with A.-Cu. and A.-St. from the west-southwest.

Pressure was low over New England and relatively high over Texas.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 24, 1911:	*mm.*	*C*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
8.27 a. m.	715.2	3.0	74	s.	6.3	526	715.2	3.0	74	s.	6.3
8.35 a. m.	715.6	2.8	78	s.	5.4	828	689.5	2.8	75	ssw.	8.3
8.42 a. m.	715.6	2.8	78	s.	5.4	526	715.6	2.8	78	s.	5.4
Dec. 25, 1911:											
9.49 a. m.	720.0	1.8	100	ese.	1.8	526	720.0	1.8	100	ese.	1.8
10.07 a. m.	720.0	0.8	100	e.	2.2	1,967	603.6	6.8	......	wsw.	....
10.25 a. m.	719.9	0.4	100	e.	3.6	1,241	659.3	7.1	......	w.	....
10.40 a. m.	719.9	0.5	100	e.	2.7	1,096	671.0	7.1	......	w.	....
10.53 a. m.	719.8	0.1	100	sse.	2.2	913	686.2	4.3	......	wsw.	....
10.58 a. m.	719.8	0.6	100	ssw.	2.2	526	719.8	0.6	100	ssw.	2.2
Dec. 27, 1911:											
First flight—											
8.52 a. m.	703.8	9.8	98	wnw.	5.8	526	703.8	9.8	98	wnw.	5.8
9.05 a. m.	703.8	10.0	98	wnw.	4.9	903	672.7	11.7	90	wsw.	17.6
9.21 a. m.	703.8	10.0	98	wnw.	4.9	1,455	629.6	8.2	81	sw.	21.6
9.38 a. m.	703.8	10.6	97	wnw.	4.5	1,936	593.7	3.5	82	sw.	17.2
9.50 a. m.	703.8	11.0	94	wsw.	4.0	2,309	567.0	0.8	49	sw.	25.0
10.10 a. m.	703.8	11.6	91	wsw.	5.8	2,481	555.0	−0.5	31	sw.	....
10.58 a. m.	703.7	9.0	90	nw.	9.8	526	703.7	9.0	90	nw.	9.8
Second flight—											
1.18 p. m.	703.9	6.8	60	nw.	21.5	526	703.9	6.8	60	nw.	21.5
1.25 p. m.	703.9	6.9	61	wnw.	24.1	842	677.1	2.6	58	wnw.	30.4
1.43 p. m.	704.0	5.8	62	wnw.	20.6	1,088	656.6	−1.2	72	wnw.	31.0
1.55 p. m.	704.1	4.2	68	nw.	22.4	1,384	632.6	−2.8	77	wnw.	34.3
2.05 p. m.	704.3	3.6	69	nw.	21.5	1,507	622.6	−5.0	88	wnw.	33.7
2.20 p. m.	704.8	2.9	72	nw.	23.2	1,414	630.2	−4.4	74	wnw.	34.7
2.27 p. m.	705.0	2.6	74	nw.	22.4	1,214	646.5	−5.2	76	wnw.	....
2.47 p. m.	705.7	2.0	73	nw.	21.5	933	670.6	−3.6	77	nw.	26.1
2.55 p. m.	706.0	2.0	71	nw.	21.5	526	706.0	2.0	71	nw.	21.5

December 24, 1911.—One kite was used; lifting surface, 6.3 sq. m. Wire out, 4,000 m., at maximum altitude.

The sky was covered with St. from the south-southwest. Light rain fell after 8.34 a. m.

A low was central over Newfoundland with secondary depressions over South Carolina and Alabama. Pressure was relatively high from New England to the Gulf of Mexico.

December 25, 1911.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 2,100 m.

There was dense fog.

Pressure was high over the Middle Atlantic States, and low north of Lake Superior.

December 27, 1911.—First flight. Three kites were used; lifting surface, 20.9 sq. m. Wire out, 4,000 m.; at maximum altitude, 3,800 m.

There were 8/10 to 4/10 A.-Cu. from the northwest and 4/10 St. from the west after 10.10 a. m., altitude of St., 1,750 m. These were obscured by dense fog from 10.40 to 10.50 a. m.

Second flight. Two kites were used; lifting surface, 10.8 sq. m. Wire out, 2,200 m.; at maximum altitude, 2,000 m.

There were 7/10 to a few A.-Cu. from the southwest. There were 2/10 to 5/10 St. from the west, after 1.30 p. m. and 3/10 to 4/10 Ci. from the same direction after 2.40 p. m.

A low was central over Lake Huron. Pressure was high over Texas.

Results of free air observations.

Date and hour.	On Mount Weather, Va., 526 m.					At different heights above sea.					
	Pressure.	Temperature.	Rel. Hum.	Wind.		Height.	Pressure.	Temperature.	Rel. Hum.	Wind.	
				Direction.	Velocity.					Direction.	Velocity.
Dec. 28, 1911:	*mm.*	*C.*	%		*m. p. s.*	*m.*	*mm.*	*C.*	%		*m. p. s.*
11.04 a. m....	717.8	−5.2	43	wnw.	26.8	526	717.5	− 5.2	43	wnw.	26.8
11.12 a. m....	717.6	−5.2	44	wnw.	20.6	943	680.2	−11.4	49	wnw.	22.5
11.28 a. m....	717.4	−5.0	50	wnw.	25.0	1,436	637.2	−16.1	59	wnw.	24.5
11.38 a. m....	717.2	−5.0	51	wnw.	19.7	1,764	609.9	−17.0	52	wnw.	....
11.58 a. m....	716.9	−4.8	34	wnw.	27.7	526	716.9	− 4.8	34	wnw.	27.7
Dec. 29, 1911:											
8.47 a. m...	724.9	− 6.5	44	wnw.	13.4	526	724.9	− 6.5	44	wnw.	13.4
8.54 a. m...	724.9	− 6.5	44	wnw.	13.4	891	691.6	− 9.6	43	nw.	16.7
9.10 a. m...	724.9	− 6.1	42	wnw.	11.2	1,477	641.8	− 2.9	39	wnw.	17.0
9.27 a. m...	724.9	− 5.6	41	wnw.	13.0	2,392	571.8	− 3.3	35	w.	20.0
9.49 a. m...	725.0	− 6.0	43	wnw.	12.1	3,147	519.1	− 9.4	......	w.	33.7
10.30 a. m...	725.0	− 5.1	43	wnw.	9.4	2,542	561.0	− 5.5	......	w.	26.0
11.00 a. m...	725.1	− 4.9	41	wnw.	9.8	1,410	647.7	− 2.8	37	wnw.	16.5
11.10 a. m...	725.1	− 4.4	41	wnw.	9.4	1,208	664.6	− 6.1	36	wnw.	15.7
11.22 a. m...	725.1	− 4.3	40	wnw.	9.8	756	704.2	− 6.5	37	nw.	16.0
11.28 a. m...	725.1	− 4.0	39	wnw.	9.8	526	725.1	− 4.0	39	wnw.	9.8
Dec. 30, 1911:											
9.00 a. m...	723.3	0.0	43	e.	2.7	526	723.3	0.0	43	e.	2.7
9.07 a. m...	723.3	0.2	43	e.	2.7	1,467	643.7	− 1.3	......	w.	....
9.28 a. m...	723.3	0.2	43	e.	2.7	998	682.3	2.7	......	s.	....
9.36 a. m...	723.2	0.4	43	e.	2.7	775	701.3	3.9	......	s.	....
9.41 a. m...	723.2	0.4	43	e.	3.1	526	723.2	0.4	43	e.	3.1
Dec. 31, 1911:											
10.59 a. m...	711.3	3.1	100	s.	9.4	526	711.3	3.1	100	s.	9.4
11.00 a. m...	711.3	3.1	100	s.	8.9	609	704.2	9.6	100	s.	12.5
11.03 a. m...	711.3	3.2	100	s.	8.9	930	677.5	10.6	100	wsw.	21.7
11.10 a. m...	711.1	3.7	100	s.	8.9	1,096	663.9	10.1	100	wsw.	23.2
11.17 a. m...	711.0	3.8	100	s.	8.9	1,344	644.4	9.8	100	wsw.	....
11.44 a. m...	710.7	4.9	100	s.	8.0	1,973	597.1	5.8	100	wsw.	17.6
12.05 p. m...	710.3	5.6	100	ssw.	6.3	1,574	626.3	8.8	100	wsw.	18.4
12.18 p. m...	710.1	6.1	100	s.	6.3	1,166	657.7	11.3	100	wsw.	16.8
12.32 p. m...	709.9	4.7	100	ssw.	5.4	593	704.2	11.2	100	ssw.	9.3
12.34 p. m...	709.9	4.6	100	ssw.	5.4	526	709.9	4.6	100	ssw.	5.4

December 28, 1911.—Two kites were used: lifting surface 10.8 sq. m. Wire out 3,000 m., at maximum altitude.

There were a few St.-Cu. from the west-northwest.

Very low pressure was central over the Gulf of St. Lawrence, and high pressure was central over western Tennessee.

December 29, 1911.—Three kites were used; lifting surface, 18.9 sq. m. Wire out, 4,500 m.; at maximum altitude, 4,200 m.

There were 3/10 to 5/10 Ci. from the west-northwest and after 10 a. m. 1/10 to 5/10 A.-Cu. from the west.

High pressure was central over northern Virginia and low pressure over Nova Scotia.

December 30, 1911.—One captive balloon was used; capacity, 31.1 cu. m. Wire out, 1,500 m.

The sky was covered with A.-Cu. from the west-southwest.

Pressure was high over the middle and north Atlantic coast and low over Texas.

December 31, 1911.—Two kites were used; lifting surface, 12.6 sq. m. Wire out, 2,000 m., at maximum altitude.

There were 10/10 St. from the southwest with light fog, becoming dense at intervals.

High pressure was central over the lower St. Lawrence Valley, and low pressure was central over Wisconsin.

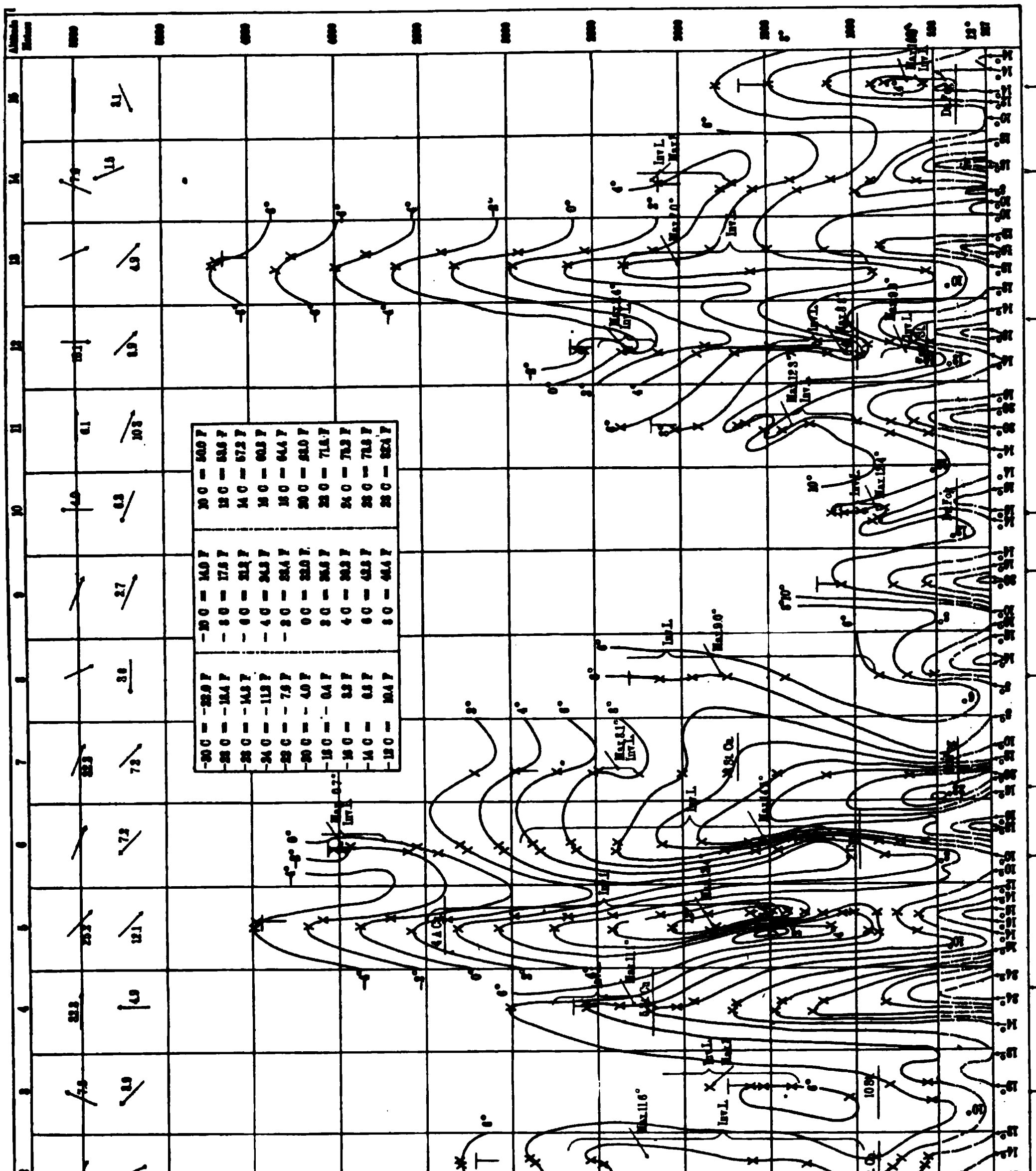

CHART XIX.—Free air isotherms, October 1-15, 1911.

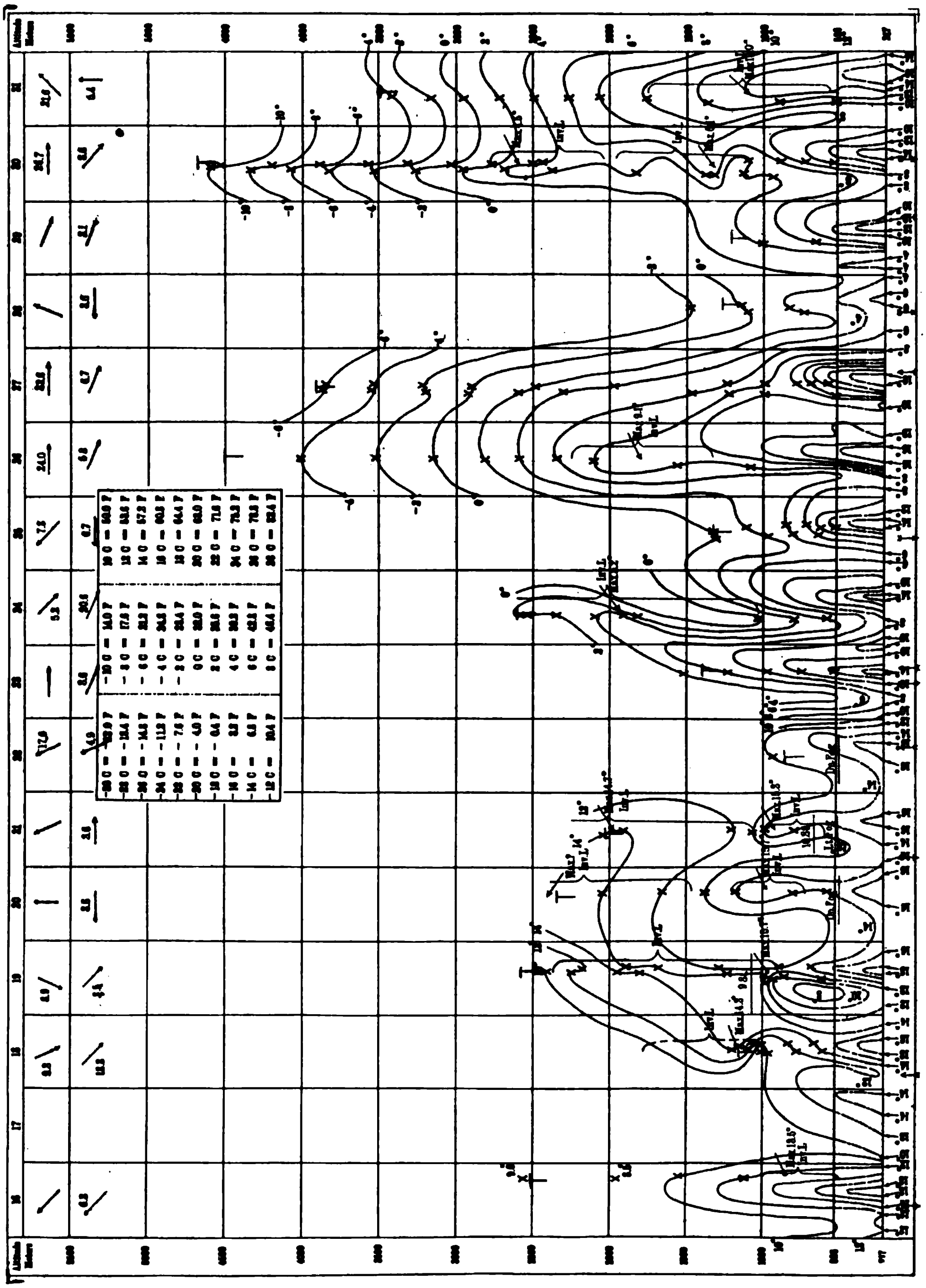

CHART XX.—Free air isotherms, October 16–31, 1911.

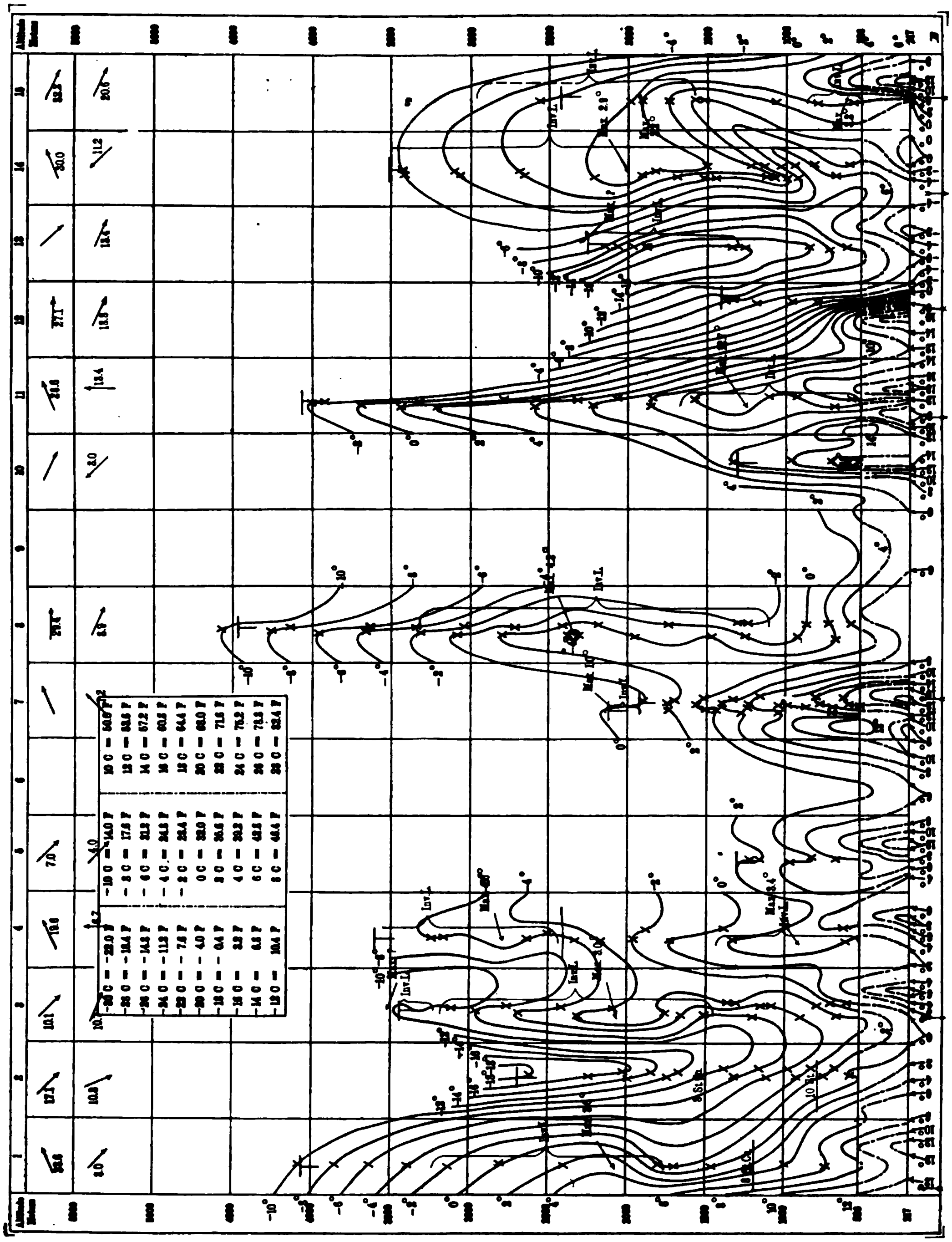

CHART XXI.—Free air isotherms, November 1-15, 1911.

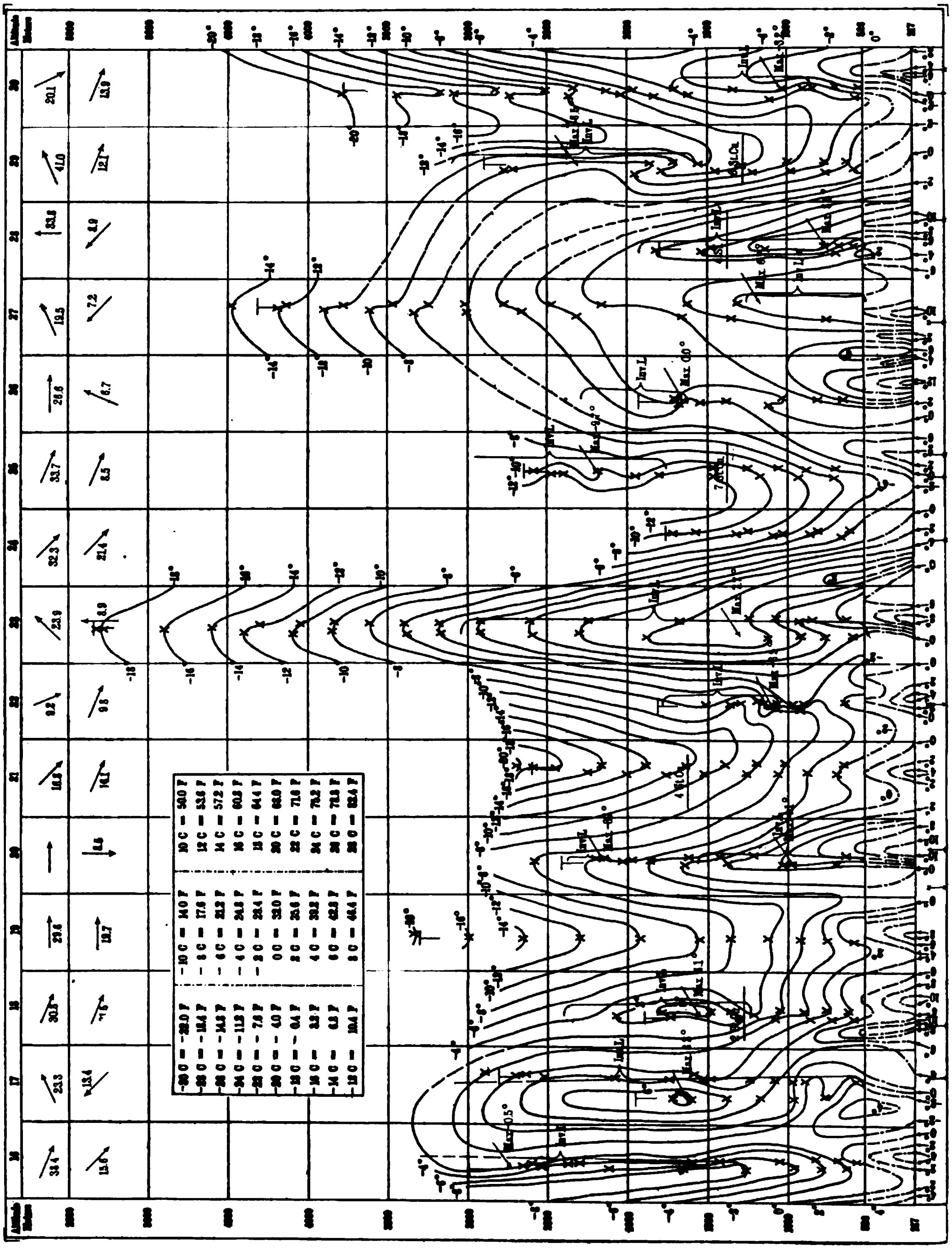

CHART XXII.—Free air isotherms, November 16–30, 1911.

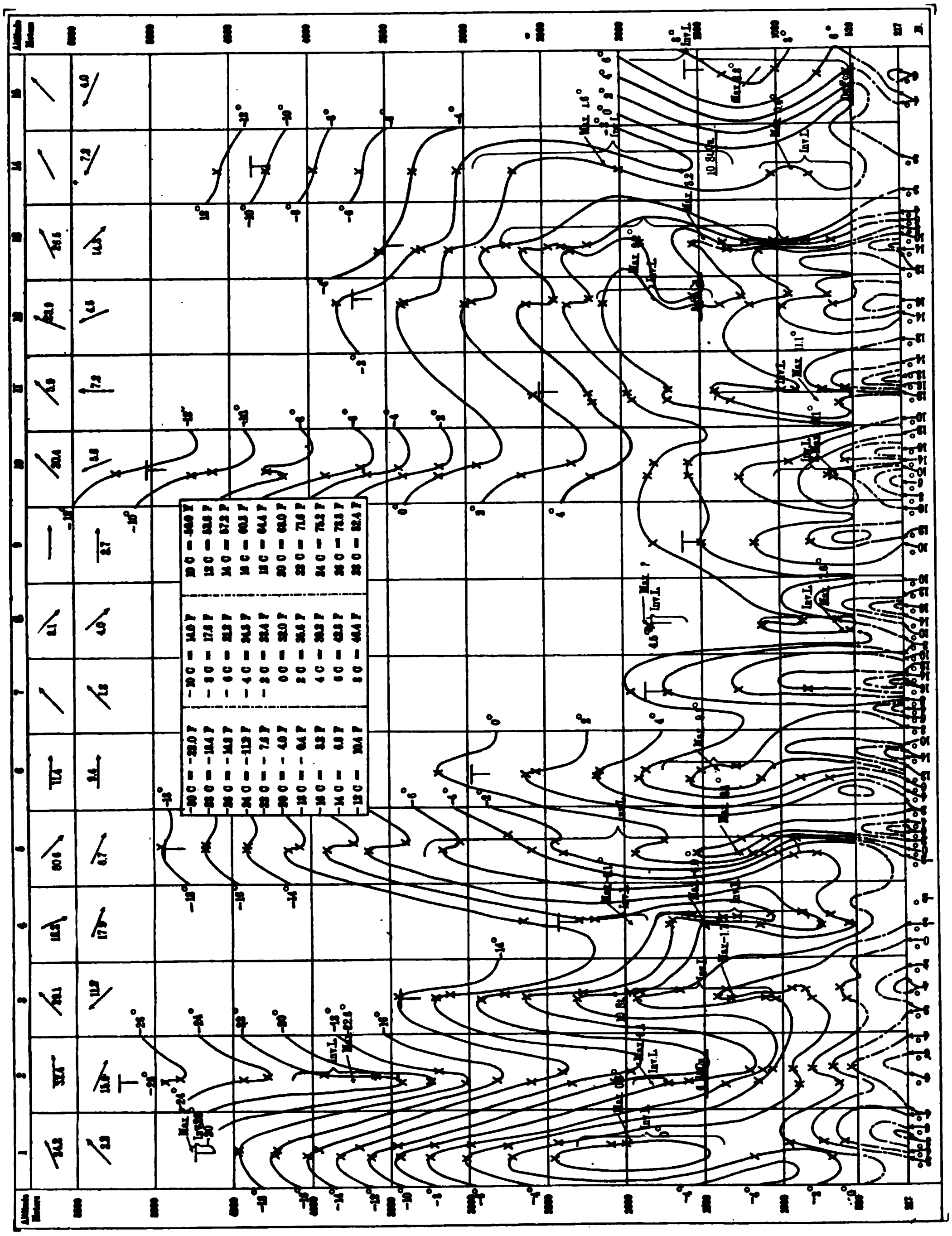

CHART XXIII.—Free air isotherms, December 1-15, 1911.

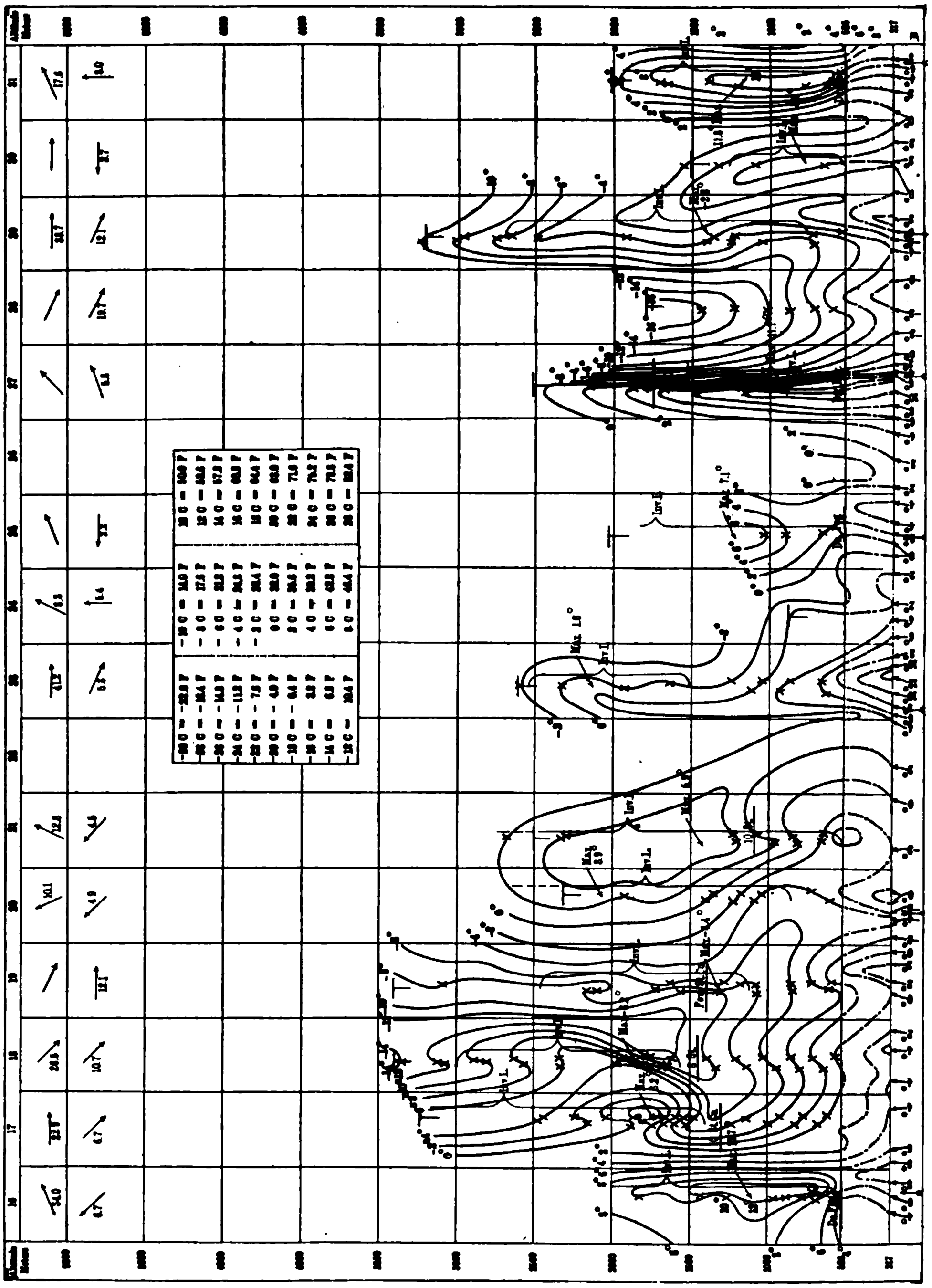

CHART XXIV.—Free air isotherms, December 16-31, 1911.

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NOTE.—Those who can spare any volumes or parts of this periodical are respectfully requested to inform the Chief of the Weather Bureau.

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